

Preface

The research presented in this report was jointly sponsored by the Department of the Army, U.S. Army Natick Research and Development Command, Operations Research and Systems Analysis Office, and the U.S. Department of Agriculture, Agricultural Marketing Service, Market Research and Development Division, Food Distribution Facilities Group. Research data contained in this report were developed in part under contract by Paul Hysen and Associates, James A. Mixon and Associates, and Kathlene Rausmussen, Registered Dietitian, and in part under cooperative agreement with the Fairfax Hospital, Fairfax, Virginia.

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This study was conducted under the general direction of K.H. Brasfield, leader, Food Distribution Facilities Group, Market Research and Development Division, Agricultural Marketing Service.

Abstract

The ready-food system of delivering hot food from the tray-assembly line using a split or divided tray (identified by the code B-2) was selected as the least-cost hospital food service system. This system was selected over the 19 other food service systems analyzed in this research.

During the conduct of this research, linear time and cost equations were developed for 32 types of food service operations. These data may be used to estimate system costs for new or expanding hospitals.

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Summary

Least-Cost Hospital Food Service Systems

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The dollar costs and worker-hour requirements to operate 5 types of kitchen subsystems, 8 types of tray delivery and sanitation subsystems, and 20 food service systems were determined in this research for 100- to 600-bed general hospitals. An overall system analysis of cost and labor-time cost was made of the 20 most popular food service systems. The costs and labor time presented in this research provide the means to evaluate additional systems by combining alternative operations for other subsystems and systems. A subsystem consists of two or more operations, and a system consists of a kitchen subsystem and a tray delivery and sanitation subsystem.

The kitchen subsystem defined by the code B was selected as the least-cost subsystem. This ready-food subsystem produces food which is packaged in multiporportioned or bulk aluminum pans, is frozen and held in storage, is removed from storage, and is delivered either thawed or hot to the patient-tray assembly operation. The data presented in this report show there is no significant cost or labor-time savings between subsystems B and B' and between subsystems C and C'. Subsystems B and C deliver thawed food to the tray assembly operation and subsystems B' and C' deliver hot food to the tray assembly operation. In a 300-bed size hospital, subsystem B has annual cost savings of \$5,300 and annual labor-time savings of 5,100 worker-hours over subsystem A. In a 300-bed size hospital, subsystem B has annual cost savings of \$198,500 and annual labor-time loss of 6,200 worker-hours over subsystem C.

Four of the eight tray delivery and sanitation subsystems, identified by codes 1, 2, 3, and 4, delivered hot food directly to patients; the remaining four, identified by the codes 5, 6, 7, and 8, delivered cold food to the patient floor pantries. The manual cart-washing operations were used in each of the eight subsystems. Annual savings of manual cart-washing in 300-bed size hospitals range from \$870 to \$2,220 over machine cart-washing operations.

Introduction

Subsystem 2 was selected as the least-cost subsystem which delivered hot food to patients. Subsystem 2 used permanent ware, split trays, and a combination hot-cold cart. In a 300-bed size hospital, subsystem 2 has annual cost savings of \$30,000 over subsystem 1, \$15,300 over subsystem 3, and \$21,500 over subsystem 4. In a 300-bed size hospital, subsystem 2 has annual labor-time savings of 800 worker-hours over subsystem 3 and requires 6,600 more worker-hours than subsystem 1 and 7,000 more worker-hours than subsystem 4.

Subsystem 7 was selected as the least-cost subsystem which delivered cold food to patient floor pantries. Subsystem 7 used permanent ware and meals were reheated at floor pantries with a convection oven. In a 300-bed size hospital, subsystem 7 has annual cost savings of \$66,200 over subsystem 5, \$89,300 over subsystem 6, and \$59,100 over subsystem 8. In a 300-bed size hospital, subsystem 7 has annual labor-time savings of 15,900 worker-hours over subsystem 5, 8,600 worker-hours over subsystem 6, and 800 worker-hours over subsystem 8.

The hospital system identified by the code B-2 was selected as the least-cost system. System B-2 uses a ready-food subsystem to deliver hot food directly to patients on permanent ware in a combination hot-cold cart. In a 300-bed size hospital, system B-2 has annual cost savings ranging from \$3,600 to \$213,700 over the other 19 systems analyzed. In a 300-bed size hospital, subsystem B-2 required more worker-hours in eight of the systems analyzed and less worker-hours in 11 of the systems analyzed.

The object of this research was to determine a least-cost hospital food service system based on an economic analysis. These results may be used as a basis for comparison by hospital boards, administrators, and food service directors in developing plans for new hospitals or renovating existing facilities. The data should not be used as a management tool in a specific hospital to develop labor schedules or department budgets.

The term "system" as used in this report consists of two types of subsystems: kitchen subsystems and the tray delivery and sanitation subsystems. A subsystem consists of two or more operations which produce completed goods or services. Appendix exhibit A briefly describes the goods and services provided by the operations in the kitchen and tray delivery and sanitation subsystems.

Food service within hospitals has been an area of very limited advances until recent years. Two factors which have directed greater attention to this area are the increasing role of dietetics in health care and the need to control rising costs. To offset the impact of escalating costs while improving patient food service, considerable effort is being expended in individual hospitals to determine the feasibility of alternative systems and operations such as convenience food, ready food, chill-plated food, decentralized pantry, and automated meal delivery. Unfortunately, most hospitals do not have the financial resources or technical staff required to conduct studies of this magnitude.

The hospital food service department is different from commercial food service in two basic ways. First, the menu variety such as regular, bland, salt-free, and liquid diets, results in a greater inventory of food products. Second, the menu selection process and inherent problems of diet changes require more sophisticated communication methods.

Several basic needs must be considered in evaluating a hospital food service system. The patient must receive nutritious, palatable, and appetizing food. A system must operate on a financially sound basis enabling hospital management to budget and control costs effectively. A proposed system must provide reasonable benefits in productivity and a demonstrated history of operational soundness.

In the selection of a hospital food service system for a specific location, regional variables such as labor cost, availability of skilled personnel, availability of food products, types of patients, and availability of support services must be considered. In order to meet these criteria, it is believed that no best system can be the solution for all these variables.

Research Methodology

The following criteria were used in selecting the hospitals which participated in this research: type of systems and operation, availability of financial data and operating statistics, use of good operating practices, availability of adequate facilities, and evidence of effective management. Data were collected onsite during 1977 for operating costs, hospital bed size (number of patient beds in the hospital), meals served, menu analysis, staffing requirements, operating practices and procedures, and other relevant information.

In order to accomplish the objectives of this research within budget restraints, qualitative and quantitative factors were standardized for the analysis of kitchen and tray delivery and sanitation subsystems. Many of the qualitative factors, such as patient menu preference and type of hospital, and many of the quantitative factors, such as meals served per patient day and number of beds per floor pantry, were standardized and used for the analysis of all the systems presented in this report. The standard labor-time and cost data presented in this report were based on requirements for 100-, 200-, 300-, 500-, and 600-bed general hospitals, serving a selected 14-day repetitive cycle menu. Production volume was based on an occupancy rate of 90 percent, 2.8 meals served per patient day, and 1.51 cafeteria meals per patient meal.

The standard labor-time and cost data for the conventional-food kitchen subsystem were based on a production mix of 55 hot and cold items per day produced 7 days a week. The standard labor-time and cost data for ready-food and convenience-food kitchen subsystems were based on a production mix of 23 hot items per day produced 5 days each week, and 13 cold items per day produced 7 days a week.

Standard time and costs per month for 100-, 200-, 300-, 400-, 500-, and 600-bed hospitals were developed for each operation described in the appendix. These data are shown in table 1. Linear time and cost equations, expressed in terms of time and cost per 100 beds for each operation, were fitted and are shown in table 2.

Linear time and cost equations for five kitchen subsystems and eight tray delivery and sanitation subsystems are shown in table 3. Linear time and cost equations for 20 hospital food service systems are shown in table 4. The linear equations shown in tables 3 and 4 were developed by adding the time and cost equations for each operation included in a subsystem or system.

Table 1.—Summary of standard time and cost per month for operations by hospital beds.

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
<hr/>					
Labor:					
Food service director	worker-hours	173.33	1,606.25	173.33	1,606.25
Assistant food service director	..... do	—	—	—	—
Chief dietitian	..... do	—	—	—	—
Secretaries	..... do	173.33	860.24	173.33	860.24
Registered dietitians	..... do	34.64	252.46	243.36	1,773.60
Dietitian clerks	..... do	—	—	243.36	1,207.80
Cafeteria supervisor	..... do	—	—	173.33	1,083.49
Food production manager	..... do	—	—	—	—
Banquet manager	..... do	—	—	—	—
Food service supervisor do	—	—	173.33	1,083.49
Total labor do	381.30	2,718.95	1,180.64	7,614.87
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Overhead:					
Menus	dollars	—	153.32	—	306.64
Equipment do	—	128.26	—	246.30
Floorspace	sq ft	216.00	51.82	432.00	103.64
Total overhead	dollars	—	333.40	—	656.58
Total operation (100) do	—	3,052.35	—	8,271.45
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Labor:					
Storeroom attendant	worker-hours	25.49	108.49	50.90	216.63
Overhead:					
Walk-in refrigeration	number	2.00	129.11	2.00	162.30
Equipment	dollars	—	25.46	—	28.87
Dry goods space	sq ft	168.00	19.08	294.00	33.40
Office space	..... do	72.00	8.18	72.00	8.18
Refrigeration space	..... do	192.00	21.81	256.00	29.08
Miscellaneous aisle space	dollars	85.00	9.66	130.00	14.77
Total overhead	dollars	—	213.30	—	276.60
Total operation (200) do	—	321.79	—	493.23
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Labor:					
Storeroom attendant	worker-hours	25.49	108.49	50.90	216.63
Overhead:					
Walk-in refrigeration	number	3.00	188.19	3.00	264.25
Equipment	dollars	—	27.97	—	33.88
Dry goods space	sq ft	168.00	19.08	294.00	33.40
Office space	..... do	72.00	8.18	72.00	8.18
Refrigeration space	..... do	325.00	36.92	665.00	75.54
Miscellaneous aisle space	..... do	85.00	9.66	130.00	14.77
Total overhead	dollars	—	290.00	—	430.02
Total operation (210)	..... do	—	398.49	—	646.65

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Management operation (100)							
173.33	2,355.83	173.33	2,355.83	173.33	2,675.00	173.33	2,675.00
—	—	173.33	1,712.00	173.33	2,033.00	173.33	2,033.00
173.33	1,719.72	173.33	1,719.72	173.33	1,719.72	173.33	1,719.72
346.66	1,720.47	346.66	1,720.47	346.66	1,720.47	346.66	1,720.47
486.72	3,547.21	730.08	5,320.81	1,216.80	8,868.02	1,460.16	10,641.42
243.36	1,207.80	730.08	3,623.39	1,216.80	6,038.98	1,460.16	7,246.77
519.99	3,250.46	519.99	3,250.46	693.32	4,333.94	866.65	5,417.43
173.33	1,364.71	173.33	1,364.71	173.33	1,364.71	173.33	1,364.71
—	—	173.33	1,083.49	173.33	1,083.49	173.33	1,083.49
519.99	3,250.46	519.99	3,250.46	519.99	3,250.46	693.32	4,333.94
2,636.71	18,416.66	3,713.45	25,401.34	4,860.22	33,087.79	5,693.60	38,235.95
—	459.96	—	613.28	—	766.60	—	919.92
—	375.27	—	490.15	—	601.87	—	708.47
720.00	172.73	864.00	202.27	1,080.00	259.09	1,152.00	276.36
—	1,007.96	—	1,305.70	—	1,627.56	—	1,904.75
—	19,424.62	—	26,707.04	—	34,715.35	—	40,140.70
Conventional-food storeroom operation (200)							
76.35	324.95	101.80	433.26	127.25	541.58	152.72	649.98
2.00	203.57	3.00	272.77	3.00	351.07	4.00	458.24
—	47.10	—	50.51	—	61.52	—	66.43
440.00	49.98	594.00	67.48	704.00	79.97	836.00	94.97
72.00	8.18	72.00	8.18	72.00	8.18	72.00	8.18
336.00	38.17	416.00	47.26	576.00	65.43	768.00	87.24
190.00	21.58	210.00	23.86	310.00	35.22	390.00	44.30
—	368.58	—	470.06	—	601.39	—	759.36
—	693.53	—	903.32	—	1,142.97	—	1,409.34
Ready-food storeroom operation (210)							
76.35	324.95	101.80	433.26	127.25	541.58	152.72	649.98
3.00	319.94	4.00	406.85	4.00	509.36	5.00	653.62
—	54.45	—	60.53	—	74.05	—	83.13
440.00	49.98	594.00	67.48	704.00	79.97	836.00	94.97
72.00	8.18	72.00	8.18	72.00	8.18	72.00	8.18
870.00	98.83	1,106.00	125.64	1,670.00	189.71	2,187.00	248.44
190.00	21.58	210.00	23.86	310.00	35.22	390.00	44.30
—	552.96	—	692.54	—	896.49	—	1,132.64
—	877.91	—	1,125.80	—	1,438.07	—	1,782.62

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
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Labor:					
Storeroom attendant	worker-hours	25.49	108.49	50.90	216.63
Overhead:					
Walk-in refrigeration	number	2.00	97.54	2.00	136.33
Equipment	dollars	—	25.46	—	28.87
Dry goods space	sq ft	168.00	19.08	294.00	33.40
Office space	----- do -----	72.00	8.18	72.00	8.18
Refrigeration space	----- do -----	204.00	23.17	500.00	56.80
Miscellaneous aisle space	----- do -----	85.00	9.66	130.00	14.77
Total overhead	dollars	—	183.09	—	278.35
Total operation (220)	----- do -----	—	291.58	—	494.98
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Labor:					
Cooks and salad preparation	worker-hours	578.99	3,652.85	769.49	4,854.71
Housekeeping	----- do -----	345.34	1,469.78	353.79	1,505.71
Total labor	----- do -----	924.33	5,122.63	1,123.28	6,360.42
Material:					
Patient meals	dollars	—	6,965.40	—	13,930.81
Bulk nourishments	----- do -----	—	674.25	—	7,348.50
Individual nourishments	----- do -----	—	390.97	—	781.93
Cafeteria meals	----- do -----	—	3,551.76	—	7,103.51
Total material	----- do -----	—	11,582.38	—	23,164.75
Overhead:					
Equipment	----- do -----	—	790.22	—	798.57
Floorspace	sq ft	1,700.00	407.83	1,700.00	407.83
Total overhead	dollars	—	1,198.05	—	1,206.40
Total operation (300)	----- do -----	—	17,903.06	—	30,731.57
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Labor:					
Cooks and salad preparation	worker-hours	365.06	1,892.47	526.22	2,727.92
Housekeeping	----- do -----	245.92	1,046.62	251.98	1,072.44
Total labor	----- do -----	610.98	2,939.09	778.20	3,800.36
Total material	dollars	—	11,582.38	—	23,164.75
Total overhead	----- do -----	—	1,198.05	—	1,206.40
Total operation (310)	----- do -----	—	15,719.52	—	28,171.51

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Convenience-food storeroom operation (220)							
76.35	324.95	101.80	433.26	127.25	541.58	152.72	649.98
2.00	166.94	2.00	198.96	2.00	230.62	2.00	270.79
—	47.10	—	50.51	—	61.52	—	66.43
440.00	49.98	594.00	67.48	704.00	79.97	836.00	94.97
72.00	8.18	72.00	8.18	72.00	8.18	72.00	8.18
600.00	68.16	776.00	88.15	970.00	110.19	1,267.00	143.93
190.00	21.58	210.00	23.86	310.00	35.22	390.00	44.30
—	361.94	—	437.14	—	525.70	—	628.60
—	686.89	—	870.40	—	1,067.28	—	1,278.58
Conventional-food production operation (300)							
959.74	6,055.00	1,150.49	7,258.44	1,340.99	8,460.31	1,531.50	9,662.23
394.64	1,679.51	403.80	1,718.57	442.32	1,882.52	451.00	1,919.44
1,354.38	7,734.51	1,554.29	8,977.01	1,783.31	10,342.83	1,982.50	11,581.67
—	20,896.21	—	27,861.82	—	34,827.02	—	41,792.43
—	2,022.75	—	2,697.00	—	3,371.26	—	4,045.21
—	1,172.90	—	1,563.86	—	1,954.83	—	2,345.80
—	10,655.27	—	14,207.03	—	17,758.78	—	21,310.54
—	34,747.13	—	46,329.51	—	57,911.89	—	69,493.98
—	1,118.19	—	1,126.54	—	1,451.09	—	1,459.44
1,900.00	455.81	1,900.00	455.81	2,100.00	503.79	2,100.00	503.79
—	1,574.00	—	1,582.35	—	1,954.88	—	1,963.23
—	44,055.64	—	56,888.87	—	70,209.60	—	83,038.88
Ready-food production operation (310)							
687.38	3,563.38	848.55	4,398.88	1,009.71	5,234.34	1,170.87	6,069.87
281.02	1,196.01	287.52	1,223.67	351.03	1,340.78	321.32	1,367.52
968.40	4,759.39	1,136.07	5,622.55	1,324.74	6,575.12	1,492.19	7,437.39
—	34,747.13	—	46,329.51	—	57,911.89	—	69,493.98
—	1,574.00	—	1,582.35	—	1,954.88	—	1,963.23
—	41,080.52	—	53,534.41	—	66,441.89	—	78,894.60

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
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<i>Labor:</i>					
Cooks and salad preparation	worker-hours	253.27	1,168.08	350.62	1,617.06
Housekeeping	----- do -----	28.16	119.86	28.16	119.86
Total labor	----- do -----	281.43	1,287.94	378.78	1,736.92
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<i>Material:</i>					
Patient meals	dollars	—	12,127.61	—	24,255.22
Bulk nourishments	----- do -----	—	674.25	—	1,348.50
Individual nourishments	----- do -----	—	390.97	—	781.93
Cafeteria meals	----- do -----	—	6,183.77	—	12,367.74
Total material	----- do -----	—	19,376.60	—	38,753.39
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<i>Overhead:</i>					
Equipment	----- do -----	—	176.49	—	184.84
Floorspace	sq ft	200.00	47.98	200.00	47.98
Total overhead	----- do -----	—	224.47	—	232.82
Total operation (320)	----- do -----	—	20,889.01	—	40,723.13
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<i>Labor:</i>					
Cashier	worker-hours	365.04	1,676.96	365.04	1,676.96
Grill cook	----- do -----	365.04	1,811.69	365.04	1,811.69
Attendant	----- do -----	66.84	284.47	133.69	568.98
Housekeeping	----- do -----	264.96	1,127.66	359.11	1,528.38
Total labor	----- do -----	1,061.88	4,900.78	1,222.88	5,586.01
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<i>Overhead:</i>					
Equipment	dollars	—	545.66	—	545.66
Tables (and chairs)	number	30.00	35.21	60.00	70.14
Space	sq ft	2,600.00	623.74	4,400.00	1,055.56
Total overhead	dollars	—	1,204.61	—	1,671.36
Total operation (400)	----- do -----	—	6,105.39	—	7,257.37
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<i>Labor:</i>					
Pot washer	worker-hours	32.48	138.23	64.96	276.47
<i>Overhead:</i>					
Equipment	dollars	—	111.38	—	111.38
Space	sq ft	182.00	43.66	182.00	43.66
Total overhead	dollars	—	155.04	—	155.04
Total operation (500)	----- do -----	—	293.27	—	431.51

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Convenience-food production operation (320)							
447.67	2,064.65	544.71	2,512.20	641.76	2,959.80	738.81	3,407.39
30.26	128.81	30.26	128.81	32.50	138.33	32.50	138.33
477.93	2,193.46	574.97	2,641.01	674.26	3,098.13	771.31	3,545.72
—	36,382.84	—	48,510.45	—	60,638.05	—	72,765.67
—	2,022.75	—	2,697.00	—	3,371.26	—	4,045.21
—	1,172.90	—	1,563.86	—	1,954.83	—	2,345.80
—	18,551.51	—	24,735.48	—	30,919.34	—	37,103.22
—	58,130.00	—	77,506.79	—	96,883.48	—	116,259.90
—	273.17	—	281.52	—	342.64	—	350.99
250.00	59.98	250.00	59.98	320.00	76.77	320.00	76.77
—	333.15	—	341.50	—	419.41	—	427.76
—	60,656.61	—	80,489.30	—	100,401.02	—	120,233.38
Cafeteria operation (400)							
365.04	1,676.96	365.04	1,676.96	365.04	1,676.96	365.04	1,676.96
365.04	1,811.69	365.04	1,811.69	365.04	1,811.69	365.04	1,811.69
200.53	853.46	267.38	1,137.97	334.22	1,422.44	401.06	1,706.91
473.19	2,013.91	574.05	2,443.16	697.23	2,967.41	786.65	3,347.98
1,403.80	6,356.02	1,571.51	7,089.78	1,761.53	7,878.50	1,917.79	8,543.54
—	604.96	—	604.96	—	714.53	—	714.53
90.00	105.21	120.00	140.28	150.00	175.35	180.00	210.42
6,400.00	1,535.36	8,200.00	1,967.18	10,200.00	2,446.98	12,000.00	2,878.80
—	2,245.53	—	2,712.42	—	3,336.86	—	3,803.75
—	8,601.55	—	9,782.20	—	11,215.36	—	12,347.29
Conventional-food machine pot-washing operation (500)							
97.25	413.90	129.73	552.13	160.46	682.92	194.50	827.79
—	149.64	—	158.99	—	158.99	—	158.99
182.00	43.66	182.00	43.66	182.00	43.66	182.00	43.66
—	193.30	—	202.65	—	202.65	—	202.65
—	607.20	—	754.78	—	885.51	—	1,030.44

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
<hr/>					
<i>Labor:</i>					
Pot washer	worker-hours	12.06	51.33	13.42	57.12
Total overhead	dollars	—	155.04	—	155.04
Total operation (501)	----- do -----	—	206.37	—	212.16
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<i>Labor:</i>					
Pot washer	worker-hours	8.75	37.24	9.73	41.41
Total overhead	dollars	—	155.04	—	155.04
Total operation (502)	----- do -----	—	192.28	—	196.45
<hr/>					
<i>Labor:</i>					
Pot washer	worker-hours	104.39	444.29	208.78	888.58
<i>Overhead:</i>					
Equipment	dollars	—	79.85	—	79.85
Space	sq ft	93.75	22.49	93.75	22.49
Total overhead	dollars	—	102.34	—	102.34
Total operation (510)	----- do -----	—	546.63	—	990.92
<hr/>					
<i>Labor:</i>					
Pot washer	worker-hours	14.77	61.58	16.02	68.18
<i>Overhead:</i>					
Equipment	dollars	—	29.73	—	29.73
Space	sq ft	106.50	1.78	106.50	1.78
Total overhead	dollars	—	31.51	—	31.51
Total operation (511)	----- do -----	—	93.09	—	99.69
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<i>Labor:</i>					
Pot washer	worker-hours	19.23	81.84	21.37	90.95
Total overhead	dollars	—	31.51	—	31.51
Total operation (512)	----- do -----	—	113.35	—	122.46

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Ready-food machine pot-washing operation (501)							
14.78	62.90	16.14	68.89	17.51	74.52	18.87	80.31
—	155.04	—	155.04	—	155.04	—	155.04
—	217.94	—	223.93	—	229.56	—	235.35
Convenience-food machine pot-washing operation (502)							
10.70	45.54	11.67	49.67	12.64	53.80	13.62	57.97
—	155.04	—	155.04	—	155.04	—	155.04
—	200.58	—	204.71	—	208.84	—	213.01
Conventional-food manual pot washing (512)							
313.17	1,332.87	417.56	1,777.16	521.96	2,221.46	626.34	2,665.74
—	79.85	—	79.85	—	79.85	—	79.85
93.75	22.49	93.75	22.49	93.75	22.49	93.75	22.49
—	102.34	—	102.34	—	102.34	—	102.34
—	1,435.21	—	1,879.50	—	2,323.80	—	2,768.08
Ready-food manual pot-washing operation (511)							
18.20	77.46	20.06	85.38	21.92	93.29	23.79	101.25
—	29.73	—	46.67	—	46.67	—	46.67
106.50	1.78	127.50	1.78	127.50	1.78	127.50	1.78
—	31.51	—	48.45	—	48.45	—	48.45
—	108.97	—	133.83	—	141.74	—	149.70
Convenience-food manual pot washing							
23.51	100.06	25.64	109.12	27.78	118.23	29.92	127.34
—	31.51	—	48.45	—	48.45	—	48.45
—	131.57	—	157.57	—	166.68	—	175.79

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
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Labor:					
Packer	worker-hours	26.64	142.76	31.29	167.68
Material:					
Half-size pans	number	220.00	58.32	400.00	106.04
Half-size lids	----- do -----	220.00	36.43	400.00	66.24
Full-size pans	----- do -----	700.00	399.70	1,300.00	742.30
Full-size lids	----- do -----	700.00	198.38	1,300.00	368.42
Total material	dollars	—	692.83	—	1,283.00
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Overhead:					
Equipment	----- do -----	—	291.26	—	399.50
Space	sq ft	441.00	105.80	803.00	192.64
Total overhead	dollars	—	397.06	—	592.14
Total operations (600)	----- do -----	—	1,232.65	—	2,042.82
<hr/>					
Labor:					
Serving-line attendants	worker-hours	362.42	1,542.46	587.96	2,502.36
Overhead:					
Equipment	dollars	—	181.36	—	201.81
Space	sq ft	800.00	191.92	800.00	191.92
Total overhead	dollars	—	373.28	—	393.73
Total operation (700)	----- do -----	—	1,915.74	—	2,896.09
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Labor:					
Serving-line attendants	worker-hours	362.42	1,542.46	587.96	2,502.36
Overhead:					
Equipment	dollars	—	156.86	—	174.18
Space	sq ft	800.00	191.92	800.00	191.92
Total overhead	dollars	—	348.78	—	366.10
Total operation (710)	----- do -----	—	1,891.24	—	2,868.46
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Labor:					
Food handlers	worker-hours	251.88	1,072.00	503.76	2,144.00
Overhead:					
Equipment	dollars	—	80.01	—	583.17
Space	sq ft	540.00	95.47	832.00	147.10
Total overhead	dollars	—	175.48	—	730.27
Total operation (801)	----- do -----	—	1,247.48	—	2,874.27

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Packaging and freezing operation (600)							
37.03	198.44	42.85	229.63	48.25	258.57	53.11	284.62
600.00	159.06	780.00	206.78	970.00	257.15	1,090.00	288.96
600.00	99.36	780.00	129.17	970.00	160.63	1,090.00	180.50
1,990.00	1,136.29	2,650.00	1,513.15	3,330.00	1,901.43	3,930.00	2,244.03
1,990.00	563.97	2,650.00	751.01	3,330.00	943.72	3,930.00	1,113.75
—	1,958.68	—	2,600.11	—	3,262.93	—	3,827.24
—	482.80	—	582.92	—	698.57	—	806.12
1,018.00	244.22	1,380.00	331.06	1,743.00	418.15	2,105.00	504.99
—	727.02	—	913.98	—	1,116.72	—	1,311.11
—	2,884.14	—	3,743.72	—	4,638.22	—	5,422.97
Hot-plate tray-assembly operation (700)							
906.17	3,856.66	1,162.60	4,948.04	1,274.12	5,422.66	1,501.57	6,390.68
—	358.91	—	377.71	—	445.77	—	455.79
1,008.00	241.82	1,008.00	241.82	1,080.00	259.09	1,080.00	259.00
—	600.73	—	619.53	—	704.86	—	714.88
—	4,457.39	—	5,567.57	—	6,127.52	—	7,105.56
Chill-plate tray-assembly operation (710)							
906.17	3,856.66	1,162.00	4,948.04	1,274.12	5,422.66	1,501.57	6,390.68
—	280.06	—	295.73	—	372.34	—	379.24
800.00	191.92	800.00	191.92	800.00	191.92	800.00	191.92
—	471.98	—	487.65	—	564.26	—	571.16
—	4,328.64	—	5,435.69	—	5,986.92	—	6,961.84
Conventional pantry, tray-delivery operation (801)							
755.64	3,216.00	1,007.52	4,288.00	1,259.40	5,360.00	1,511.28	6,432.00
—	892.06	—	1,250.83	—	1,553.10	—	1,855.74
1,124.00	198.72	1,576.00	278.65	1,900.00	335.92	2,224.00	393.21
—	1,090.78	—	1,529.48	—	1,889.02	—	2,248.95
—	4,306.78	—	5,817.48	—	7,249.02	—	8,680.95

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
Labor:					
Food handlers	worker-hours	958.53	4,079.50	1,917.06	8,159.00
Overhead:					
Equipment	dollars	—	461.49	—	900.10
Space	sq ft	709.00	123.35	1,170.00	206.85
Total overhead	dollars	—	584.84	—	1,106.95
Total operation (803)	----- do -----	—	4,664.34	—	9,265.95
Labor:					
Food handlers	worker-hours	516.53	2,198.53	1,033.06	4,397.06
Overhead:					
Equipment	dollars	—	515.93	—	1,010.99
Space	sq ft	631.00	111.56	1,014.00	179.27
Total overhead	dollars	—	627.49	—	1,190.26
Total operation (805)	----- do -----	—	2,826.02	—	5,587.32

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Microwave pantry, tray-delivery operation (803)							
2,875.59	12,238.50	3,834.12	16,318.00	4,792.65	20,397.50	5,571.18	24,477.00
—	1,339.71	—	1,883.70	—	2,357.80	—	2,804.67
1,631.00	228.36	2,252.00	398.17	2,745.00	458.32	3,238.00	572.48
—	1,628.07	—	2,281.87	—	2,816.12	—	3,377.15
—	13,866.57	—	18,599.87	—	23,213.62	—	27,854.15
Convection pantry, tray-delivery operation (805)							
1,549.59	6,595.59	2,066.12	8,794.12	2,582.65	10,992.65	3,099.18	13,191.18
—	1,506.04	—	2,105.47	—	2,621.40	—	3,377.15
1,397.00	246.99	1,940.00	343.01	2,355.00	416.36	2,770.00	489.74
—	1,753.03	—	2,448.48	—	3,037.96	—	3,627.07
—	8,348.62	—	11,242.60	—	14,030.41	—	16,818.25

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
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Labor:					
Food handlers	worker-hours	516.53	2,198.53	1,033.06	4,397.06
Overhead:					
Equipment	dollars	—	551.87	—	1,080.86
Space	sq ft	709.00	123.35	1,170.00	206.85
Total overhead	dollars	—	675.22	—	1,287.71
Total operation (806)	----- do -----	—	2,873.75	—	5,684.77
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Labor:					
Dishwashers	worker-hours	375.17	1,596.72	681.89	2,902.12
Material and services:					
Dishware and diet kits	dollars	—	794.91	—	1,589.82
Trays, pellet bases, and covers	----- do -----	—	139.80	—	279.60
Electricity	kwh	204.40	13.29	408.00	26.57
Steam	mlbs	22.20	99.90	44.40	199.80
Water	mgal	21.77	34.83	43.54	69.66
Detergent	dollars	—	81.76	—	163.52
Total material and services	----- do -----	—	1,164.49	—	2,328.97
Overhead:					
Equipment	----- do -----	—	108.55	—	108.55
Space	sq ft	525.00	125.95	525.00	125.95
Total overhead	dollars	—	234.50	—	234.50
Total operation (900)	----- do -----	—	2,995.71	—	5,465.59
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Labor:					
Dishwashers	worker-hours	353.54	1,504.67	638.64	2,718.05
Material and services:					
Dishware	dollars	—	794.91	—	1,589.82
Trays and covers	----- do -----	—	53.10	—	106.20
Electricity	kwh	106.79	6.94	213.58	13.88
Steam	mlbs	11.63	52.34	23.26	104.67
Water	mgal	20.35	32.56	40.70	65.12
Detergent	dollars	—	76.42	—	152.84
Total material and services	----- do -----	—	1,062.75	—	2,125.68
Total overhead	----- do -----	—	234.50	—	234.50
Total operation (910)	----- do -----	—	2,801.92	—	5,078.23

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Integral-heat tray-delivery operation (806)							
1,549.59	6,595.59	2,066.12	8,794.12	2,582.65	10,922.65	3,099.18	13,191.18
—	1,610.85	—	2,245.22	—	2,809.58	—	3,346.95
1,631.00	288.36	2,252.00	398.17	2,745.00	458.32	3,238.00	572.48
—	1,899.21	—	2,643.39	—	3,267.90	—	3,919.43
—	8,494.80	—	11,437.51	—	14,190.55	—	17,110.61
Pellet-base dishwashing operation (900)							
988.62	4,207.57	1,295.34	5,512.97	1,602.07	6,818.41	1,908.27	8,121.60
—	2,384.73	—	3,179.64	—	3,974.55	—	4,769.46
—	419.40	—	559.20	—	696.00	—	838.80
613.20	39.86	817.60	53.14	1,022.00	66.43	1,226.40	79.42
44.10	198.45	58.80	264.60	73.50	330.75	88.20	396.90
43.23	69.17	57.64	92.22	72.05	115.28	86.46	138.34
—	245.28	—	327.04	—	408.80	—	490.56
—	3,356.89	—	4,475.84	—	5,591.81	—	6,713.48
—	354.46	—	354.46	—	484.72	—	484.72
525.00	125.95	525.00	125.95	630.00	151.14	630.00	151.14
—	480.41	—	480.41	—	635.86	—	635.86
—	8,044.87	—	10,469.22	—	13,046.08	—	15,470.94
Split-tray or chill-plate dishwashing operation (910)							
923.73	3,931.39	1,208.83	5,144.78	1,493.93	6,358.71	1,779.02	7,571.51
—	2,384.73	—	3,179.64	—	3,974.55	—	4,769.46
—	159.30	—	212.40	—	265.20	—	318.60
320.37	20.82	427.16	27.76	533.95	34.70	640.74	41.64
34.88	156.96	46.51	209.30	50.14	261.63	69.77	313.97
40.41	64.66	53.88	86.21	67.35	107.76	80.82	129.31
—	229.26	—	305.68	—	382.10	—	458.52
—	3,060.46	—	4,080.61	—	5,100.46	—	6,120.91
—	480.41	—	480.41	—	635.86	—	635.86
—	7,472.26	—	9,705.80	—	12,095.03	—	14,328.28

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
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Labor:					
Dishwashers	worker-hours	134.58	572.77	269.16	1,145.54
Material and services:					
Tray rental	dollars	—	498.28	—	996.56
Single service, patients	----- do -----	—	1,081.42	—	2,162.84
Single service, cafeteria	----- do -----	—	703.74	—	1,407.48
Trash-removal labor	worker-hours	16.11	68.56	32.22	137.13
Trash collection	tons	5.93	296.50	11.88	594.00
Cafeteria trays	dollars	—	22.50	—	45.00
Electricity	kwh	50.92	3.31	101.84	6.62
Steam	mlbs	5.54	24.93	11.08	49.86
Water	mgal	9.64	15.42	19.28	30.84
Detergent	dollars	—	36.21	—	72.42
Total material and service	----- do -----	—	2,772.75	—	5,546.51
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Overhead:					
Equipment	----- do -----	—	96.03	—	96.03
Equipment space	sq ft	266.00	63.81	266.00	63.81
Trash collection space	----- do -----	200.00	22.73	400.00	45.45
Total overhead	dollars	—	182.57	—	205.29
Total operation (920)	----- do -----	—	3,528.09	—	6,897.34
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Labor:					
Dishwashers	worker-hours	375.17	1,596.72	681.89	2,902.12
Material and services:					
Patient dish rental	dollars	—	1,551.42	—	3,102.84
Dishware and diet kits	----- do -----	—	749.69	—	1,499.38
Trays	----- do -----	—	37.50	—	75.00
Electricity	kwh	115.00	7.48	230.00	14.96
Steam	mlbs	12.52	56.34	25.04	112.68
Water	mgal	21.77	34.83	43.54	69.66
Detergent	dollars	—	81.76	—	163.52
Total material and services	----- do -----	—	2,568.39	—	5,136.77
Total overhead	----- do -----	—	234.50	—	234.50
Total operation (930)	----- do -----	—	4,399.61	—	8,273.39

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Single service, Insulated-tray dishwashing operation (920)							
403.74	1,718.32	538.32	2,291.09	672.90	2,863.86	807.48	3,436.63
—	1,494.84	—	1,993.12	—	2,491.40	—	2,989.68
—	3,244.26	—	4,325.68	—	5,407.10	—	6,488.52
—	2,111.22	—	2,814.96	—	3,518.70	—	4,222.44
48.34	205.74	64.45	274.30	80.56	342.86	96.67	411.43
17.79	889.50	23.72	1,186.00	29.65	1,482.50	35.58	1,779.00
—	67.50	—	90.00	—	112.50	—	135.00
152.76	9.93	9.93	203.68	13.24	254.60	305.52	19.86
16.62	74.79	22.16	99.72	27.70	124.65	33.24	149.58
28.92	46.26	38.56	61.68	48.20	77.10	57.84	92.52
—	108.63	—	144.84	—	181.05	—	217.26
—	8,318.31	—	11,091.09	—	13,863.81	—	16,635.26
—	96.03	—	96.03	—	96.03	—	96.03
266.00	63.81	266.00	63.81	266.00	63.81	266.00	63.81
600.00	68.81	800.00	90.91	1,000.00	113.64	1,200.00	136.36
—	228.02	—	250.75	—	273.48	—	296.50
—	10,264.25	—	13,632.93	—	17,001.15	—	20,368.39
Integral heat-plate dishwashing operation (930)							
988.62	4,207.57	1,295.34	5,512.97	1,602.07	6,818.41	1,908.27	8,121.60
—	4,654.26	—	6,205.68	—	7,757.10	—	9,308.52
—	2,249.07	—	2,998.76	—	3,748.55	—	4,498.14
—	112.50	—	150.00	—	187.50	—	225.00
345.00	22.44	460.00	29.92	575.00	37.40	690.00	44.88
37.56	169.02	50.08	225.36	62.60	281.70	75.12	338.04
43.34	69.17	57.64	92.22	72.05	115.28	86.46	138.34
—	245.28	—	327.04	—	408.80	—	490.56
—	7,568.59	—	10,091.44	—	12,614.41	—	15,136.88
—	480.41	—	480.41	—	635.86	—	635.86
—	12,256.57	—	16,084.82	—	20,068.68	—	23,894.34

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
Labor:					
Dishwashers	worker-hours	105.59	449.39	211.18	898.78
Material and services:					
Single service, patients	dollars	—	1,437.19	—	2,874.38
Single service, cafeteria	----- do -----	—	703.74	—	1,407.48
Trays	----- do -----	—	37.50	—	75.00
Tray removal labor	worker-hours	16.11	68.56	32.22	137.13
Trash collection	tons	5.93	296.50	11.88	594.00
Electricity	kwh	23.10	1.50	46.20	3.00
Steam	mlbs	2.52	11.34	5.04	22.68
Water	mgal	4.38	7.01	8.76	14.02
Detergent	dollars	—	16.45	—	32.90
Total material and services	----- do -----	—	2,589.74	—	5,136.77
Total overhead	----- do -----	—	182.57	—	205.29
Total operation (940)	----- do -----	—	3,221.70	—	6,284.56
Labor:					
Cart washer	worker-hours	29.51	125.28	55.67	236.93
Overhead:					
Closed carts	number	5.00	52.73	10.00	105.46
Cleaning and ventilation equipment	dollars	—	20.88	—	20.88
Space	sq ft	219.00	52.54	294.00	70.54
Total overhead	dollars	—	126.15	—	196.88
Total operation (1001)	----- do -----	—	251.43	—	433.81
Labor:					
Cart washer	worker-hours	29.51	125.88	55.67	236.93
Overhead:					
Hot-cold carts	number	5.00	94.03	10.00	188.06
Cleaning and ventilation equipment	dollars	—	20.88	—	20.88
Space	sq ft	219.00	52.54	294.00	70.54
Total overhead	dollars	—	167.45	—	279.48
Total operation (1002)	----- do -----	—	293.33	—	516.41

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Single service dishwashing operation (940)							
316.77	1,348.77	422.36	1,797.56	527.95	2,246.96	633.54	2,696.35
—	4,311.57	—	5,748.76	—	7,185.95	—	8,623.14
—	2,111.22	—	2,814.96	—	3,518.70	—	4,222.44
—	112.50	—	150.00	—	187.50	—	225.00
48.34	205.74	64.45	274.30	80.56	342.86	96.67	411.43
17.79	889.50	23.72	1,186.00	29.65	1,482.50	35.58	1,779.00
89.30	4.50	92.40	6.00	115.50	7.50	138.60	9.00
7.56	34.02	10.08	45.36	12.60	56.70	15.12	68.04
13.14	21.03	17.52	28.04	21.90	35.05	26.28	42.06
—	49.35	—	65.80	—	82.25	—	98.70
—	—	—	10,359.01	—	12,948.75	—	15,537.50
—	228.02	—	250.75	—	273.48	—	296.50
—	9,346.07	—	12,407.32	—	15,469.79	—	18,530.05
Manual closed cart-washing operation (1001)							
82.74	352.15	110.42	469.97	139.02	591.67	167.92	714.66
15.00	158.19	20.00	210.92	25.00	263.65	30.00	316.38
—	20.88	—	20.88	—	20.88	—	20.88
369.00	88.53	444.00	106.52	519.00	124.51	594.00	142.51
—	267.60	—	338.32	—	409.04	—	479.77
—	619.75	—	808.29	—	1,000.71	—	1,194.43
Manual hot-cold cart-washing operation (1002)							
82.74	352.15	110.42	469.97	139.02	591.67	167.92	714.66
15.00	282.09	20.00	376.12	25.00	470.15	30.00	564.18
—	20.88	—	20.88	—	20.88	—	20.88
369.00	88.53	444.00	106.52	519.00	124.51	594.00	142.51
—	391.50	—	503.52	—	615.54	—	727.57
—	743.65	—	973.49	—	1,207.21	—	1,442.23

Table 1.—Summary of standard time and cost per month for operations by hospital beds. (continued)

Item Description	Basic determinant	100 beds		200 beds	
		Quantity	Cost	Quantity	Cost
		Number	Dollars	Number	Dollars
<hr/>					
Labor:					
Cart washer	worker-hours	20.69	88.04	38.03	161.33
Overhead:					
Open carts	number	5.00	17.36	10.00	34.72
Cleaning and ventilation equipment	dollars	—	20.88	—	20.88
Space	sq ft	219.00	52.54	294.00	70.54
Total overhead	dollars	—	90.78	—	216.14
Total operation (1003)	----- do -----	—	178.82	—	287.97
<hr/>					
Labor:					
Cart washer	worker-hours	25.86	110.05	46.85	119.38
Overhead:					
Closed carts	number	5.00	52.73	10.00	105.46
Washing equipment	dollars	—	195.00	—	195.00
Space	sq ft	150.00	35.98	225.00	53.98
Total overhead	dollars	—	283.71	—	354.44
Total operation (1011)	----- do -----	—	393.76	—	473.82
<hr/>					
Labor:					
Cart washer	worker-hours	25.86	110.05	46.85	119.38
Overhead:					
Hot-cold carts	number	5.00	94.03	10.00	188.06
Washing equipment	dollars	—	195.00	—	195.00
Space	sq ft	150.00	35.98	225.00	53.98
Total overhead	dollars	—	325.01	—	437.06
Total operation (1012)	----- do -----	—	435.06	—	556.42
<hr/>					
Labor:					
Cart washer	worker-hours	25.86	110.05	46.85	119.38
Overhead:					
Open carts	number	5.00	17.36	10.00	34.72
Washing equipment	dollars	—	195.00	—	195.00
Space	sq ft	150.00	35.98	225.00	53.98
Total overhead	dollars	—	248.34	—	283.70
Total operation (1013)	----- do -----	—	394.39	—	403.08

300 beds		400 beds		500 beds		600 beds	
Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars
Manual open cart-washing operation (1003)							
52.28	239.51	75.14	319.78	94.91	403.94	115.29	490.68
15.00	52.08	20.00	69.44	25.00	86.80	30.00	104.16
—	20.88	—	20.88	—	20.88	—	20.88
369.00	88.53	444.00	106.52	519.00	124.51	594.00	142.51
—	161.49	—	196.84	—	232.19	—	287.55
—	401.00	—	516.62	—	636.13	—	758.23
Machine closed cart-washing operation (1011)							
67.53	287.42	88.52	376.75	109.21	464.19	130.29	554.12
15.00	158.19	20.00	210.92	25.00	263.65	30.00	316.38
—	195.00	—	195.00	—	195.00	—	195.00
300.00	71.97	375.00	89.96	450.00	107.95	525.00	125.95
—	425.16	—	495.88	—	566.60	—	637.33
—	712.58	—	872.63	—	1,030.79	—	1,191.45
Machine hot-cold cart-washing operation (1012)							
67.53	287.42	88.52	376.75	109.21	464.19	130.29	554.12
15.00	282.09	20.00	376.12	25.00	470.15	30.00	564.18
—	195.00	—	195.00	—	195.00	—	195.00
300.00	71.97	375.00	89.96	450.00	107.95	525.00	125.95
—	549.06	—	661.08	—	773.10	—	885.13
—	836.48	—	1,037.83	—	1,237.29	—	1,439.25
Machine open cart-washing operation (1013)							
67.53	287.42	88.52	376.75	109.21	464.19	130.29	554.12
15.00	52.08	20.00	69.44	25.00	86.80	30.00	104.16
—	195.00	—	195.00	—	195.00	—	195.00
300.00	71.97	375.00	89.96	450.00	107.95	525.00	125.95
—	319.05	—	354.40	—	389.75	—	425.11
—	606.47	—	731.15	—	853.94	—	979.23

Table 2.—Summary of standard linear time and cost equations by operation.¹

Code	Operation description	Time per month				Cost per month			
		Slope (a)	Intercept (b)	R ²	Sy.x ²	Slope (a)	Intercept (b)	R ²	Sy.x ³
Number		Hours	Hours	Number	Hours	Dollars	Dollars	Number	Dollars
100	Management	1,105.108	- 790.32	.99	172.14	7,773.025	- 5,153.67	.99	1,555.29
200	Conventional storeroom	25.447	.02	1.00	.02	217.050	67.69	.99	34.62
210	Ready-food storeroom	25.447	.02	1.00	.02	272.651	90.64	.99	46.81
220	Convenience-food storeroom	25.447	.02	1.00	.02	195.297	98.08	1.00	8.05
300	Conventional-food production	213.453	706.59	1.00	9.05	13,055.612	4,776.63	1.00	144.28
310	Ready-food production	177.524	430.43	1.00	6.47	12,661.155	2,993.03	1.00	133.40
320	Convenience-food production	98.082	183.16	1.00	.61	19,873.948	1,006.59	1.00	27.00
400	Cafeteria	173.234	883.58	1.00	8.91	1,264.689	4,791.78	1.00	74.95
500	Conventional machine								
	pot-washing	32.259	.32	1.00	.69	148.567	148.45	1.00	12.64
501	Ready-food machine								
	pot-washing	1.362	10.69	1.00	.00	5.803	200.58	1.00	.08
502	Convenience-food machine								
	pot-washing	.973	7.78	1.00	.00	4.141	188.15	1.00	.02
510	Conventional-manual								
	pot-washing	104.391	.00	1.00	.00	444.291	102.34	1.00	.01
511	Ready-food manual								
	pot-washing	1.847	12.66	1.00	.21	12.401	77.76	.96	5.11
512	Convenience-food manual								
	pot-washing	2.137	17.09	1.00	97.48	13.453	97.48	.97	4.94
600	Packaging and freezing	5.401	20.96	1.00	.37	845.639	367.68	1.00	28.43
700	Hot food, tray assembly	228.876	164.74	.98	60.21	1,050.100	1,002.95	.98	292.36
710	Chill plate, tray assembly	228.859	164.74	.98	60.10	1,023.301	997.25	.98	265.44
801	Conventional pantry, tray								
	delivery	251.880	.00	1.00	.00	1,479.965	- 150.55	1.00	62.98
803	Microwave pantry,								
	tray delivery	958.530	.00	1.00	.00	4,643.533	- 8.34	1.00	36.38
805	Convection pantry,								
	tray delivery	516.530	.00	1.00	.00	2,805.269	- 9.57	1.00	37.39
806	Integral-heat pantry,								
	tray delivery	516.530	.00	1.00	.00	2,846.981	.90	1.00	45.21
900	Pellet base, dishwashing	306.650	68.62	1.00	.18	2,501.199	494.54	1.00	42.12
910	Split tray or chill plate								
	dishwashing	285.096	68.44	1.00	.00	2,311.878	488.68	1.00	43.60
920	Single-service insulated tray,								
	dishwashing	134.580	.00	1.00	.00	3,388.053	160.64	1.00	.52
930	Integral heat, dishwashing	306.650	68.62	1.00	.18	3,950.365	494.12	1.00	42.97
940	Single service, dishwashing	105.590	.00	1.00	.00	3,036.625	160.79	1.00	.56
1001	Manual, closed cart, washing	27.708	.57	1.00	1.09	186.693	57.65	1.00	4.52
1002	Manual, hot-cold cart,								
	washing	27.708	.57	1.00	1.09	228.906	58.05	1.00	4.69
1003	Manual, open cart washing	19.043	.59	1.00	2.57	115.919	57.41	1.00	4.59
1011	Machine closed cart, washing	20.863	5.02	1.00	.10	166.269	197.23	.99	33.33
1012	Machine hot-cold cart,								
	washing	20.863	5.02	1.00	.10	207.569	197.23	.99	33.33
1013	Machine, open cart, washing	20.853	5.02	1.00	.10	130.899	197.23	.99	33.33

¹ Linear equations expressed in terms of $Y = ax + b$, where x is hundreds of patient beds.

² Coefficient of determination.

³ Standard error of estimate.

Table 3.—Standard time and cost equations by subsystem.¹

Subsystem description	Time per month		Cost per month	
	Slope (a)	Intercept (b)	Slope (a)	Intercept (b)
	<i>Hours</i>	<i>Hours</i>	<i>Dollars</i>	<i>Dollars</i>
<i>Kitchen</i>				
A Conventional food	1,778.38	964.93	23,509.04	5,633.83
B Ready food, chill plate	1,717.42	722.03	23,852.86	4,164.47
B' Ready food, hot plate	1,717.44	722.07	23,879.66	4,170.17
C Convenience food, chill plate	1,632.87	458.23	30,143.71	1,837.51
C' Convenience food, hot plate	1,632.88	458.27	30,170.51	1,843.21
<i>Delivery and sanitation</i>				
1. Single service, insulated tray	405.50	— .59	4,963.92	67.50
2. Split tray or chill plate	564.68	69.01	4,021.75	396.18
3. Pellet base	586.24	69.19	4,167.86	401.64
4. Single service	385.18	.57	4,728.28	67.89
5. Microwave pantry, pot washing	1,271.33	69.01	7,142.10	537.99
6. Microwave pantry, single service	1,091.83	.57	7,891.85	210.10
7. Convection pantry	829.33	69.01	5,303.84	536.76
8. Integral heat	850.89	69.19	6,939.04	552.67

¹ Linear equations expressed in terms of $Y = ax + b$, where x is hundreds of patient beds.

Standard Labor Costs and Times

Standard labor costs are the product of standard hours multiplied by standard wage rates. Standard wage rates are defined as basic hourly wage rates plus fringe benefits of 28.4 percent. The basic hourly wage rates and standard wage rates used in this research are shown in table 5.

Table 4.—Standard time and cost equations by system¹.

System code	Time per month		Cost per month	
	Slope (a)	Intercept (b)	Slope (a)	Intercept (b)
	Hours	Hours	Hours	Hours
A-1	2,183.88	964.34	28,472.96	5,701.33
A-2	2,343.06	1,033.94	27,530.79	6,030.01
A-3	2,364.62	1,034.12	27,676.90	6,065.47
A-4	2,163.56	965.50	28,237.32	5,701.72
B-1	2,122.92	721.44	28,816.78	4,234.97
B-2	2,282.10	791.04	27,874.61	4,563.65
B-3	2,303.66	791.22	28,020.72	4,569.11
B-4	2,102.60	722.60	28,581.14	4,235.36
B-5	2,988.75	791.04	30,994.96	4,705.46
B-6	2,809.25	722.60	31,744.71	4,377.57
B-7	2,546.75	791.04	29,156.70	4,704.23
B-8	2,568.31	791.22	30,791.90	4,720.14
C-1	2,038.37	457.64	35,107.63	1,905.01
C-2	2,197.55	527.24	34,165.46	2,233.69
C-3	2,219.11	527.42	34,311.75	2,239.15
C-4	2,018.05	458.80	34,871.99	1,905.40
C-5	2,904.20	527.24	37,285.81	2,375.50
C-6	2,724.70	458.80	38,035.56	2,047.61
C-7	2,462.20	527.24	35,447.55	2,374.27
C-8	2,483.76	527.42	37,082.75	2,390.18

¹ Linear equations expressed in terms of $Y = ax + b$, where x is hundreds of patient beds.

Table 5.—Standard hourly wage rates.

Pay grade	Basic cost per hour	Standard cost per hour
Number	Dollars	Dollars
4-1	3.315	4.256
5-1	3.578	4.594
6-1	3.865	4.963
7-1	4.174	5.359
8-1	4.508	5.788
9-1	4.868	6.251
11-1	5.676	7.288
13-1	6.623	8.504
17-1	9.013	11.573

Standard labor times are the product of normal times multiplied by personal and fatigue allowance factors and a break allowance factor of 7 percent.¹ A personal and fatigue allowance factor of 15 percent was used for all operations except dishwashing, pot-washing, and cart-washing. A 20-percent allowance was used in the excepted operations.

Normal time is defined as the time required to complete a task by a properly trained and motivated employee using proper tools and equipment. Normal times were developed from second- and third-generation MTM (Methods Time Measurement) data for all operations with the exception of management and storeroom operations. Staffing requirements for the management operation were based on actual staffing in the participating hospital food service operations. Standard time requirements for the storeroom operation were based on research findings presented in Marketing Research Report No. 931, which is available from the U.S. Government Printing Office.

MTM was selected as the industrial engineering technique to develop the labor productivity measures in this research for three reasons. First, MTM is a predetermined time system whose entire data and research have been made available to the general public. Second, the shortcomings of a traditional time study are eliminated. These center primarily on the observed worker's skill or training level, physical and psychological factors affecting the worker, and the ability of the time study observer to accurately record time and judge the tempo of work. Third, second- and third-generation MTM requires less engineering time to develop labor productivity measures than traditional time study. MTM data were developed at the Engineering Council, Pittsburgh, Pa., from an extensive analysis of motion picture film of employees engaged in various jobs.² This research determined time requirements for basic body motions.

Second- and third-generation MTM condenses the data found in MTM tables by combining basic body mo-

¹ Based on two 15-minute paid break allowances per day. Thirty minutes divided by (480 minutes minus 30 minutes) equals 7 percent.

² For additional information on MTM, see *Methods Time Measurement*, Maynard, H.B., Stegermerten, G.J., and Schwab, J.L., McGraw-Hill Book Co., New York, 1978, 292 pp.; and *Engineered Work Measurement*, Karger, D.W., and Bayha, F.H., Industrial Press, Inc., New York, 1965, 772 pp.

tions. This method has been successfully applied on a wide variety of assembly work in both Europe and the United States. A computer-simulated program using second-generation MTM has shown that 50 percent of all work requiring a time interval from 0 to 7.2 seconds has an error exceeding 5 percent. Ninety percent of all work requiring a time interval from 7.2 to 10.8 seconds has an error of less than 4 percent.³ The majority of tasks performed in all food service operations exceed 7.8 seconds.

Standard Material Costs

Standard material costs consist primarily of food cost. The food costs used in this report were based on modified historical data obtained from an electronic data processing program used in one of the participating hospitals.

The standard material costs shown in this report were developed for material and supplies which were indirectly issued through a central ingredient room. Computer simulation of direct issue material from the storeroom showed a cost of \$1.077 per meal. Indirect issue of material through an ingredient room showed a cost of \$0.909 per meal, a cost savings of \$0.168 per meal or 16 percent. This verified findings of prior research.⁴

Standard Overhead Costs

Standard overhead costs per month consist of equipment and floorspace costs. Equipment costs are depreciated over a 10-year period with the exception of walk-in coolers and freezers, which are depreciated over a 15-year period. Interest expense was not included in depreciation costs. Floorspace construction cost for patient floors was \$70 per square foot; for food production, \$95 per square foot; and for food storage, \$45 per square foot. Space construction costs are depreciated over a 33-year period. Utility costs, with the exception of dishwashing operations, and other costs for items such as building repair and maintenance, were not included in this report. In the hospitals participating in this research, these costs were prorated on a square footage basis, and in many instances did not reflect the true cost of the food service system. Utility

costs were included in all dishwashing operations for purposes of comparing single-service costs.

One of the initial problems encountered during the conduct of this study was the determination of adequate storage space for food products. The three primary factors which have the greatest impact on reducing food costs are (1) use of standardized menus and adherence to portion control, (2) storeroom issues of food quantities required by production, and (3) bulk purchasing and storing food from vendors. The most common deterrent to achieving these factors was insufficient storage space in the participating hospitals. Unpublished research findings show that minimal cost savings of 5 percent may be realized through bulk purchasing practices.⁵ A 300-bed hospital using bulk purchasing practices would realize annual cost savings in excess of \$25,000 over hospitals that purchase on an as-needed basis.⁶ Based on the data presented in table 1 for a 300-bed conventional hospital, storage space and equipment costs are \$21.305 per square foot.⁷

A hospital purchasing food on an as-needed basis could readily justify the expansion of existing space to 3,500 square feet to realize the cost savings generated through bulk purchasing practices.⁸ This amount of space, 3,500 square feet, is more than adequate for a 600-bed hospital.

Standard quantities and costs were developed for conventional-, ready-, and convenience-food storeroom operations on the basis that all hospitals have an ethical obligation for the continuing health and welfare of patients in emergency situations created by adverse weather conditions or civil unrest. The total storage requirements were developed for a 16-day period based on an 8-day length of patient stay and a selective 14-day menu cycle. Storage space includes area for receiving vendor products and storing finished products requiring temporary storage for more than 1 day before delivering to patients and cafeteria customers. Quantities and costs for such items as cook's reach-in coolers are included in food production operations.

³ Unpublished due to proprietary nature.

⁴ $\$0.909 \text{ cost/meal} \times .05 \text{ savings} \times 46,179 \text{ meals/month} \times 12 = \$25,186.$

⁷ $\$368.58 \text{ total overhead} \times 60 \text{ months} \div 1,038 \text{ square feet} = \$21.305 \text{ square feet}.$

⁸ $\$25,000 \text{ savings per year} \times 3 \text{ years break-even} \div \$21.305 \text{ per square foot} = 3,520 \text{ square feet}.$

⁵ Additional details concerning MTM and computer simulation may be obtained from H.B. Maynard and Co., Inc., Maynard Bldg., 21040 Ardmore Blvd., Pittsburgh, Pa. 15221.

⁴ *Hospitals*, Journal of American Hospital Association. Bansal, Ambrish K., April 1973, pp. 98-100.

Kitchen Subsystems

Five types of kitchen subsystems were analyzed in this research: conventional-food kitchen subsystem A, ready-food kitchen subsystems B and B', and convenience-food kitchen subsystems C and C'. The specific component operations of each subsystem are shown in figure 1.

The primary difference between ready-food kitchen subsystem B and B', and between convenience-food kitchen subsystems C and C', is the method of plating food in the tray-assembly operation. Subsystems B and C have chill-plate tray-assembly operations and subsystems B' and C' have hot-plate tray-assembly operations.

Conventional-Food Kitchen Subsystem

Theoretically, the conventional-food kitchen subsystem produces menu items from a fresh or natural state. In practice, a pure conventional-food system does not exist. Many items such as ice cream, bread, and canned and frozen vegetables can be purchased at a lower cost than if produced on the premises.

With a conventional-food kitchen subsystem, the operator has the flexibility to prepare almost any food item on short notice. Management has complete control of the recipes used, the quality of products, plus supervision of preparation.

Conventional food preparation requires a complement of skilled employees, such as chefs, bakers, and first cooks. In areas where the labor market cannot provide these types of skills, severe limitations are placed on the operation.

A conventional-food kitchen subsystem produces many items daily, which results in small-scale inefficiencies. This calls for accurate forecasting by management to avoid excessive preparation and food waste. Figure 2 shows the location of operations in conventional-food kitchen subsystem A for a 300-bed general hospital. The figure also shows the locations of dishwashing, item 14, and cart-washing, item 17. These two operations are a part of tray delivery and sanitation subsystem 2, which is discussed elsewhere in this report.

Items 5, 11, and 16 in figure 2 show the location of areas for operation 100, management.

Figure 3, items 1 through 8, and figure 4, item 19, show typical arrangements of office furniture.

Item 19 in figure 2 shows the flow of incoming food and supplies from vendors into storeroom operation number 200. Items 1 through 10 in figure 4 show equipment locations for this operation. Food and supplies are stored in dry goods, items 1 and 7; cooler, item 9; and freezer, item 8; storage areas.

Food production, operation 300, is comprised of ingredient room, hot- and cold-food production, nourishments and late-tray assembly. Items 4, 6, 7, and 9 in figure 2 show the locations of these areas. Items 20, 21, 22, and 25 show product flow into and out of operation 300. The food production office, item 5, is centrally located to provide overall observation of kitchen activities. Items 10 through 49 in figure 4 show equipment locations for operation 300.

Figure 1.—Operation components of kitchen subsystems.

Operation Code	Operation description	Kitchen subsystem components				
		Convenience A	Ready-food chill plate B	Ready-food hot plate B'	Convenience-food chill plate C	Convenience-food hot plate C'
100	Management	X	X	X	X	X
200	Conventional-food storeroom	X				
210	Ready-food storeroom		X	X		
220	Convenience-food storeroom				X	X
300	Conventional-food production	X				
310	Ready-food production		X	X		
320	Convenience-food production				X	X
400	Cafeteria	X	X	X	X	X
500	Conventional food, machine pot-washing	X				
511	Ready food, manual pot-washing		X	X		
512	Convenience food, manual pot-washing				X	X
600	Packaging and freezing		X	X		
700	Hot-plate, tray assembly	X		X		X
710	Chill-plate, tray assembly		X		X	

Figure 2.—Conventional-food kitchen subsystem for a 300-bed hospital.

Facilities Schedule

1. Dry goods storage
2. Freezer storage
3. Cooler storage
4. Ingredient room
5. Food production office
6. Hot-food production
7. Cold-food production
8. Pot-washing
9. Nourishments and late-tray assembly
10. Cafeteria serving line
11. General office
12. Patient-tray assembly
13. Janitor's closet
14. Dishwashing
15. Cafeteria seating
16. Director's office
17. Cart-washing
18. Clean-cart storage
19. Incoming foods flow
20. Issued goods flow from storeroom and ingredient room
21. Finished cold-products flow to cafeteria serving line and clean tray and silverware to cafeteria serving line
22. Finished hot-products flow to cafeteria serving line
23. Clean dish-return flow to cafeteria serving line
24. Clean dish-return flow to patient-tray assembly
25. Hot- and cold-food flow to patient-tray assembly
26. Clean-tray and silverware flow to tray station
27. Replenishment flow to condiment station
28. Cafeteria line entrance
29. Cafeteria line exit to cafeteria seating
30. Emergency exits (2)
31. Served cafeteria-tray flow
32. Cafeteria customer exit
33. Served patient-tray flow
34. Assembled patient-tray flow
35. Employee entrance

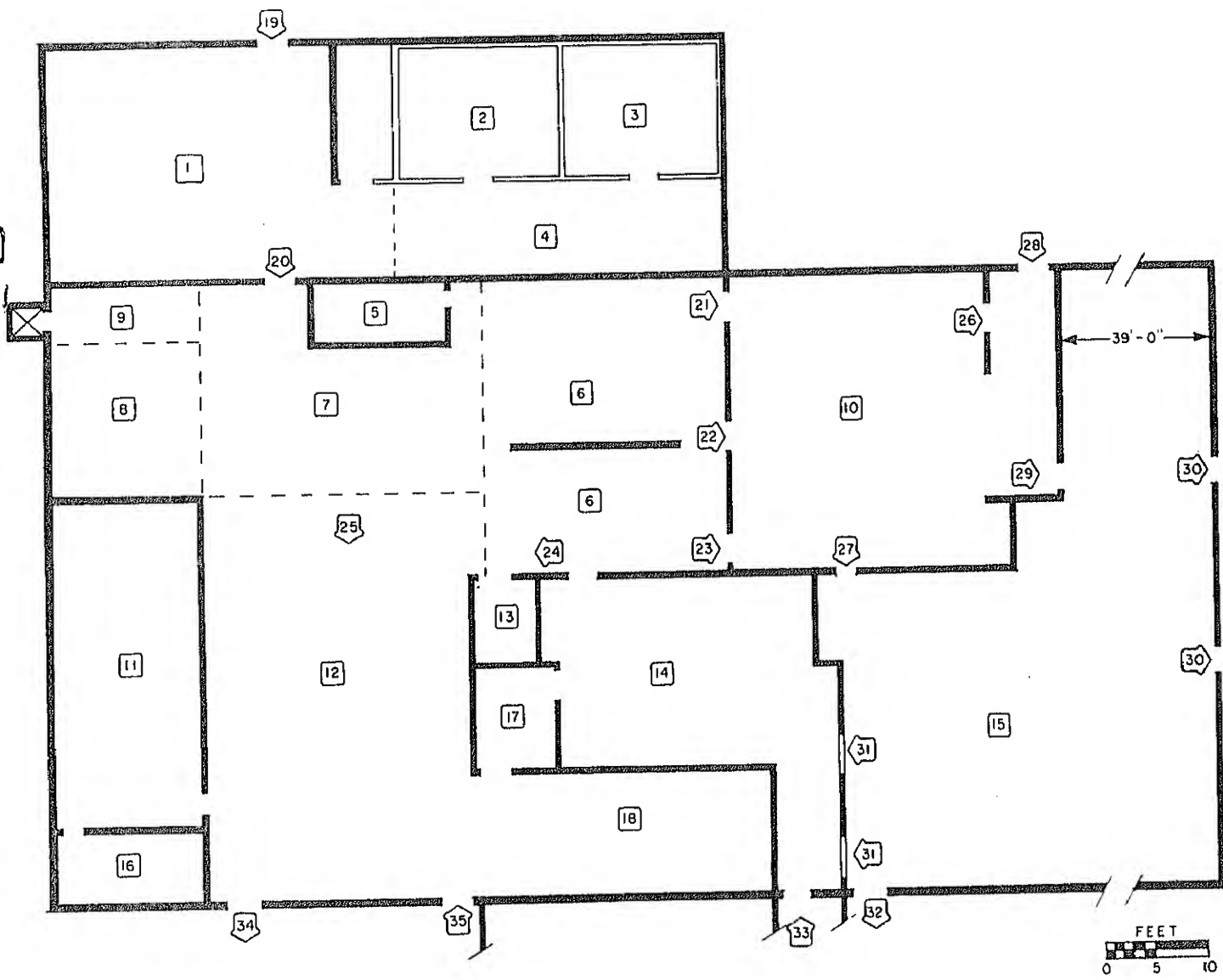
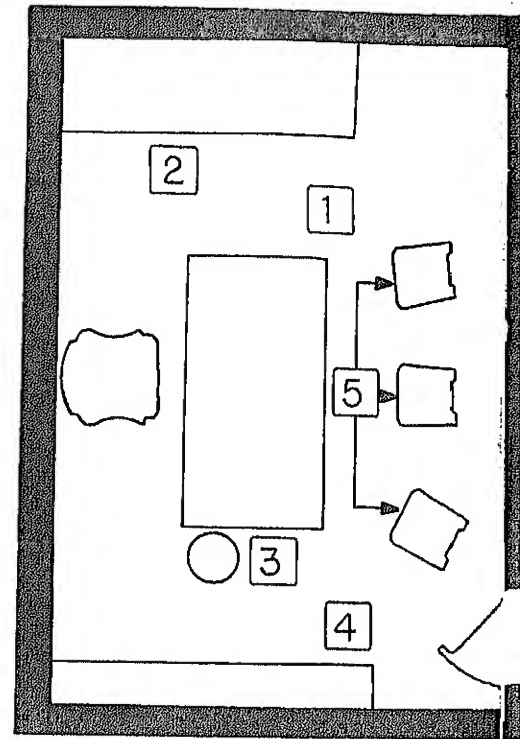


Figure 3.—General office layout.

Equipment Schedule

- | | |
|-----------------------------------|------------------------------|
| 1. Food service director's office | 5. Side chairs (6) |
| 2. Side table | 6. Secretary's desk |
| 3. Desk, chair, and wastebasket | 7. File cabinets (12) |
| 4. Bookcase | 8. Desks and chairs (6 each) |



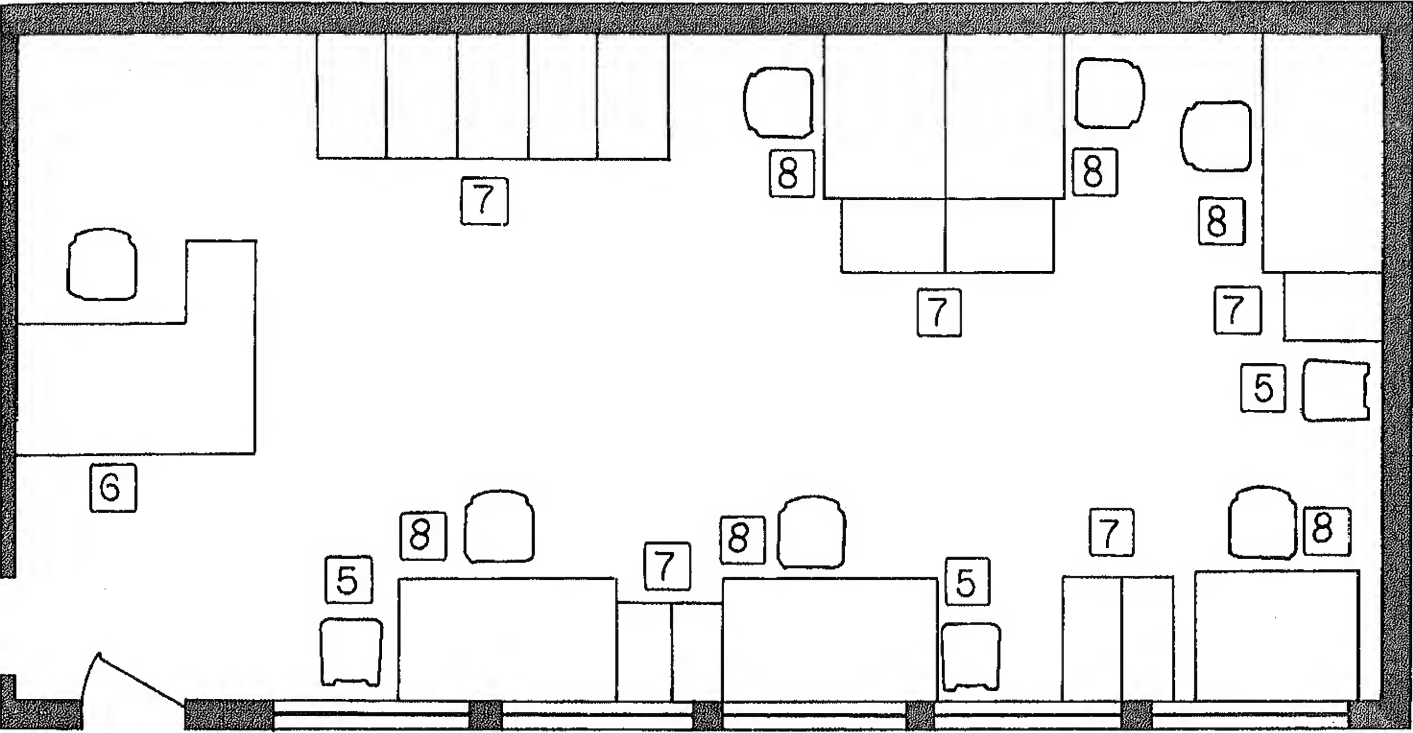
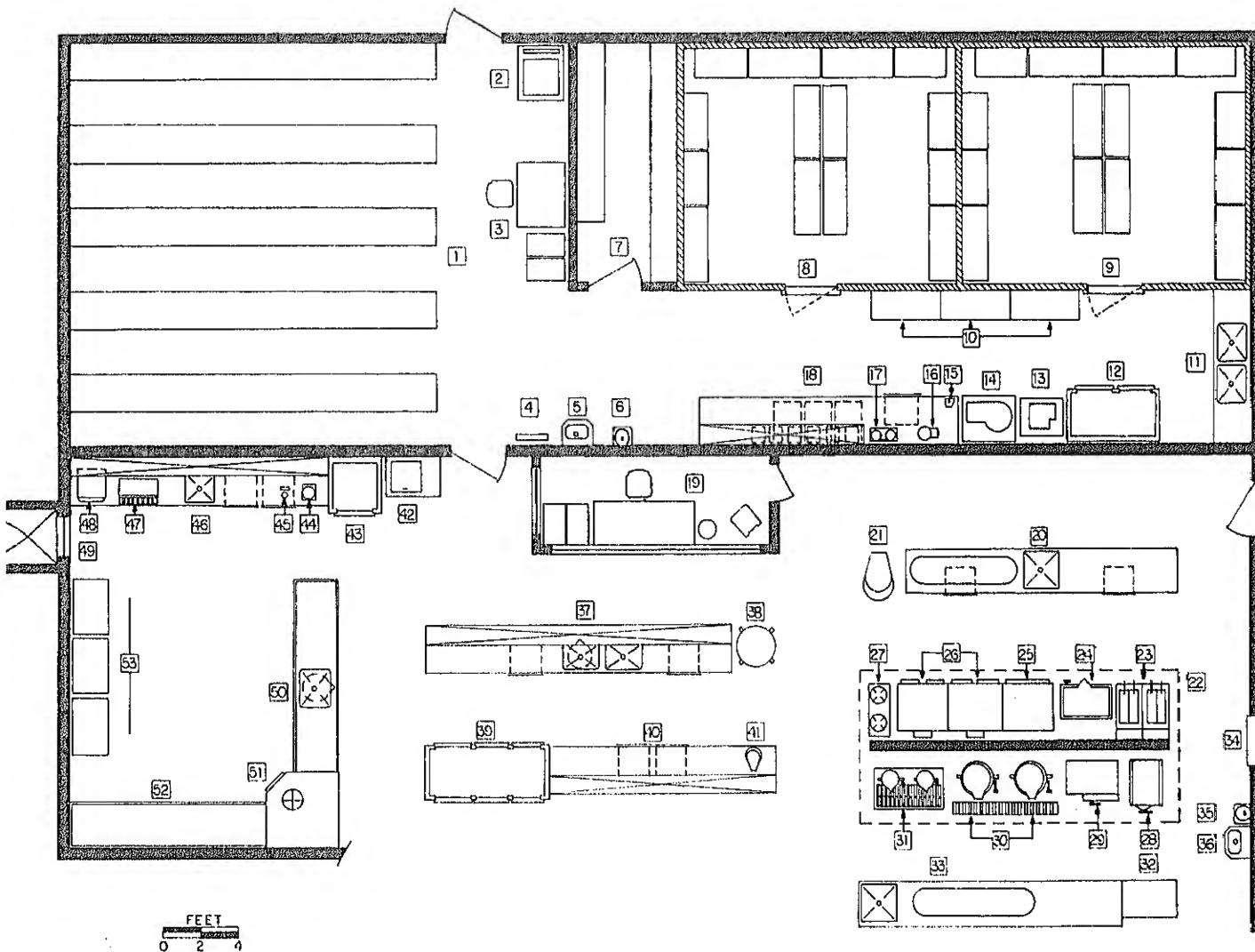


Figure 4.—Storeroom, food production, and pot-washing operations.

Equipment Schedule

1. Dry goods storage
2. Receiving scale
3. Chair, desk, and file cabinets (3)
4. Handtruck
5. Hand sink
6. Water fountain
7. Secured dry goods storage
8. Walk-in freezer
9. Walk-in cooler
10. Mobile racks (3)
11. Double-compartment sink with drainboards
12. Reach-in cooler
13. Slicer on mobile stand
14. Food cutter on mobile stand
15. Can opener
16. Portion scale
17. Portion scale
18. Stainless steel worktable/overshelf spice bins, drawer and under-table storage bins
19. Elevated food production supervisor's office/desk chairs (2), and wastebasket
20. Stainless steel worktable/single-compartment sink, drawers (2), and overhead pot rack
21. Floor mixer, 20-quart
22. Exhaust canopy
23. Deep-fat fryers (2)
24. Tilting braising kettle
25. Broiler, warming oven
26. Deck convection ovens (2)
27. Two-burner unit on stand
28. High-pressure steamer
29. Convection steamer
30. Tilting steam kettles (2), 20-gallon
31. Tilting steam kettles (2), 20-quart, on stand
32. Pot- and pan-storage rack
33. Stainless steel worktable/drawers (2), overhead utensil rack, and single-compartment sink
34. Hot-food and pass-through window
35. Water fountain
36. Hand sink
37. Stainless steel worktable/double-compartment sink, garbage disposal, drawers (2), and overshelf
38. Stainless steel mixing bowl on mobile stand
39. Pass-through rack cooler
40. Stainless steel worktable/drawers (2), overhead utensil rack, and single-compartment sink
41. Mixer, 5-quart
42. Ice machine
43. Reach-in cooler
44. Blender
45. Malt mixer
46. Stainless steel worktable/single-compartment sink, drawers (2), and overshelf
47. Cold-beverage dispenser
48. Microwave oven
49. Dumbwaiter
50. Soiled pot- and pan-landing table/single-compartment sink disposal, and overhead spray-rinse arm
51. Pot- and pan-washing machine
52. Clean pot and pan table
53. Pot- and pan-storage racks (3)



Item 8 in figure 2 shows the locations of machine pot-washing operation 500. Location details of equipment for operation 500 are shown in figure 4, items 50 through 53.

Item 10 in figure 2 shows the location of cafeteria operation 400. Items 28, 29, 30, and 32 show customer flow to and through the cafeteria. Location details of equipment for operation 400 are shown in figure 5, items 1 through 30.

Item 12 in figure 2 shows the location of tray-assembly operation 700. Items 25 and 34 show food flow to and through operation 700. Location details of equipment for operation 700 are shown in figure 6, items 1 through 31.

Ready-Food Kitchen Subsystem

The ready-food kitchen subsystem produces menu items from semifinished food products as well as from a fresh and natural state. The menu items are prepared on-premise in the conventional manner, portioned, packaged, and then blast-frozen in either individual or multiportion packages for use at a later time. Ready-food kitchen subsystems producing multiportioned packages were analyzed in this research. Fewer menu items are produced each day in greater quantities than the conventional subsystem. Menu items are produced for inventory in quantities sufficient for several weeks.

The ready-food subsystem uses skilled personnel producing food for inventory 40 hours per week. This minimization of long hours and holiday weekend work facilitates employee recruiting and hiring.

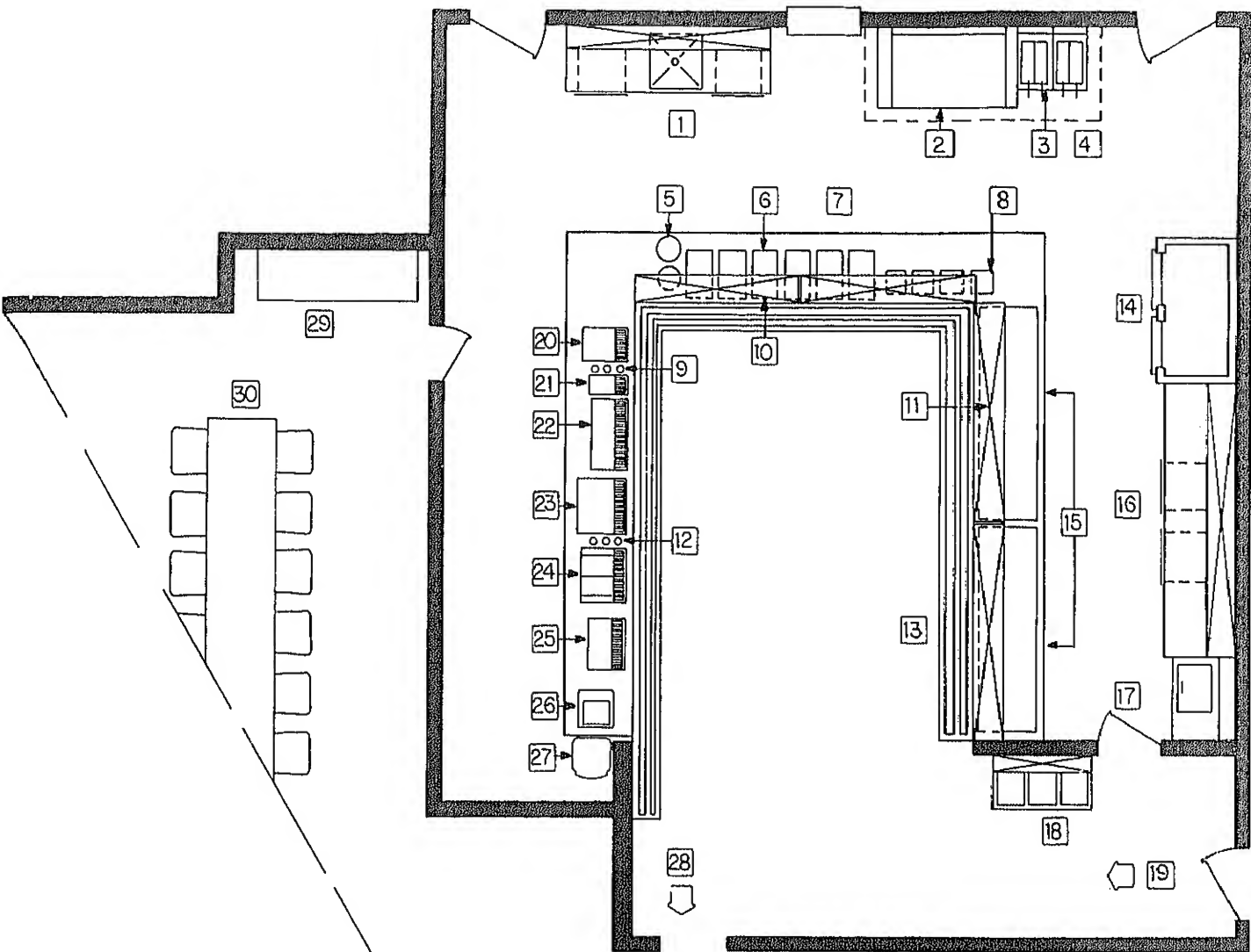
Figure 7 shows the location of operations in ready-food kitchen subsystem B' for a 300-bed hospital. The figure also shows the locations of dishwashing, item 17, and cart-washing, item 16. These two operations are a part of tray delivery and sanitation subsystem 2, which is discussed elsewhere in this report.

The ready-food kitchen subsystem shown in figure 7 is similar to the conventional subsystem in figure 2 with the following exceptions: locations of hot- and cold-food production have been exchanged; the janitor's closet has been located adjacent to the food production office; a packaging and freezing operation, items 12 and 15, has been added, and a manual pot-washing operation has replaced the machine pot-washing operation.

Figure 5.—Cafeteria operation.

Equipment Schedule

1. Stainless steel worktable/overshelf, single-compartment sink and drawers (2)
2. Grill
3. Deep-fat fryers (2)
4. Exhaust canopy
5. Soup wells (2)
6. Hot-food wells (6)
7. Stainless steel serving table/undercounter plate storage
8. Garnish wells (4)
9. Cup dispensers (3)
10. Sneeze guard
11. Sneeze guard
12. Cup dispensers (3)
13. Tray rail
14. Reach-In cooler
15. Stainless steel cold table/undercounter plate storage
16. Stainless steel worktable/overshelf and drawers (2)
17. Ice machine
18. Tray and silverware stand
19. Customer entrance
20. Milk dispenser
21. Hot chocolate dispenser
22. Coffee and hot water dispenser
23. Ice machine
24. Juice dispenser
25. Soft drink dispenser
26. Cash register
27. Cashier's chair
28. Customer exit
29. Customer condiment station
30. Cafeteria seating

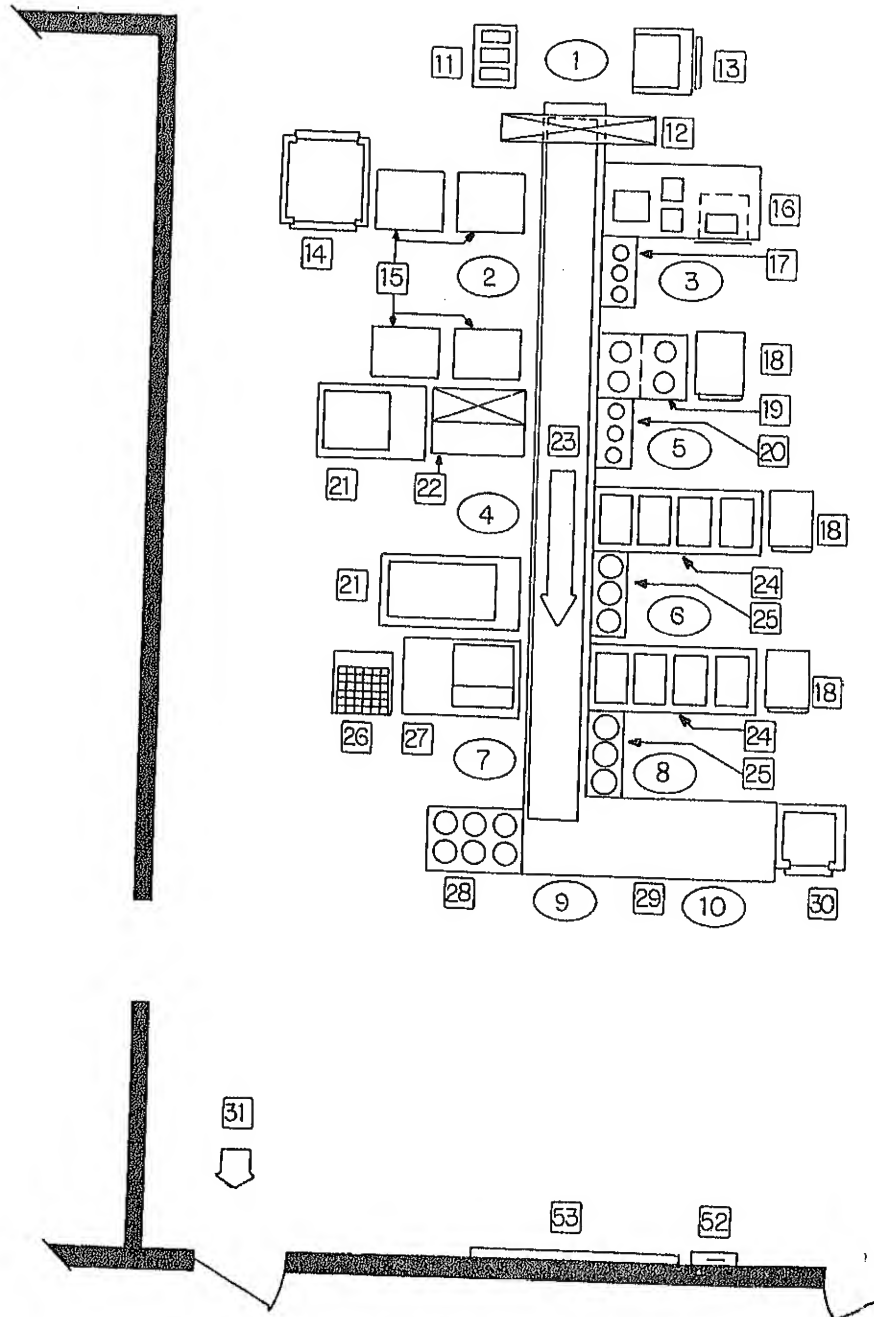


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Figure 6.—Hot-food tray-assembly and dishwashing operations.

Equipment Schedule

1. Starter position
2. Salad and dessert position
3. Bread position
4. Cold-beverage position
5. Soup position
6. Hot-food position
7. Hot-beverage position
8. Hot-food position
9. Checker position
10. Loader position
11. Condiment table
12. Overhead diet-kit rack
13. Tray-dispensing rack
14. Pass-through rack cooler
15. Mobile dessert and salad racks (4)
16. Bread table/rotary toaster, bread dispenser (2), butter dispenser, and warming drawer
17. Plate dispenser
18. Hot-food holding cabinets (2)
19. Soup wells (2)
20. Soup-bowl dispenser
21. Cold-beverage cabinets (2)
22. Cold-beverage table/inclined overshelf
23. Powered-tray conveyor
24. Hot-food tables (2)/wells (8)
25. Plate dispensers (2)
26. Mug dispenser
27. Hot-beverage table/dispenser
28. Plate-cover table
29. Checker-loader table
30. Ice cream cabinet
31. Patient-tray delivery flow
32. Patient-tray return flow
33. Powered soiled dish-return conveyor
34. Soiled dish pass-through windows (2)
35. Stainless steel soiled dish breakdown table/ scrap trough, disposal, and double overshelf
36. Mobile soiled dish-soak sinks (2)
37. Dish machine
38. Blow dryer
39. Clean-dish carts
40. Clean dish-return flow
41. Soiled cart-return flow
42. Silver sort table/drawer, overshelf and single-compartment sink
43. Overhead water-hose reel
44. Steam hose
45. Overhead cart holst/swivel
46. Exhaust canopy
47. Clean-cart storage
48. Janitor's closet
49. Storage shelving
50. Sink
51. Mop rack and buckets
52. Timeclock
53. Timecard rack



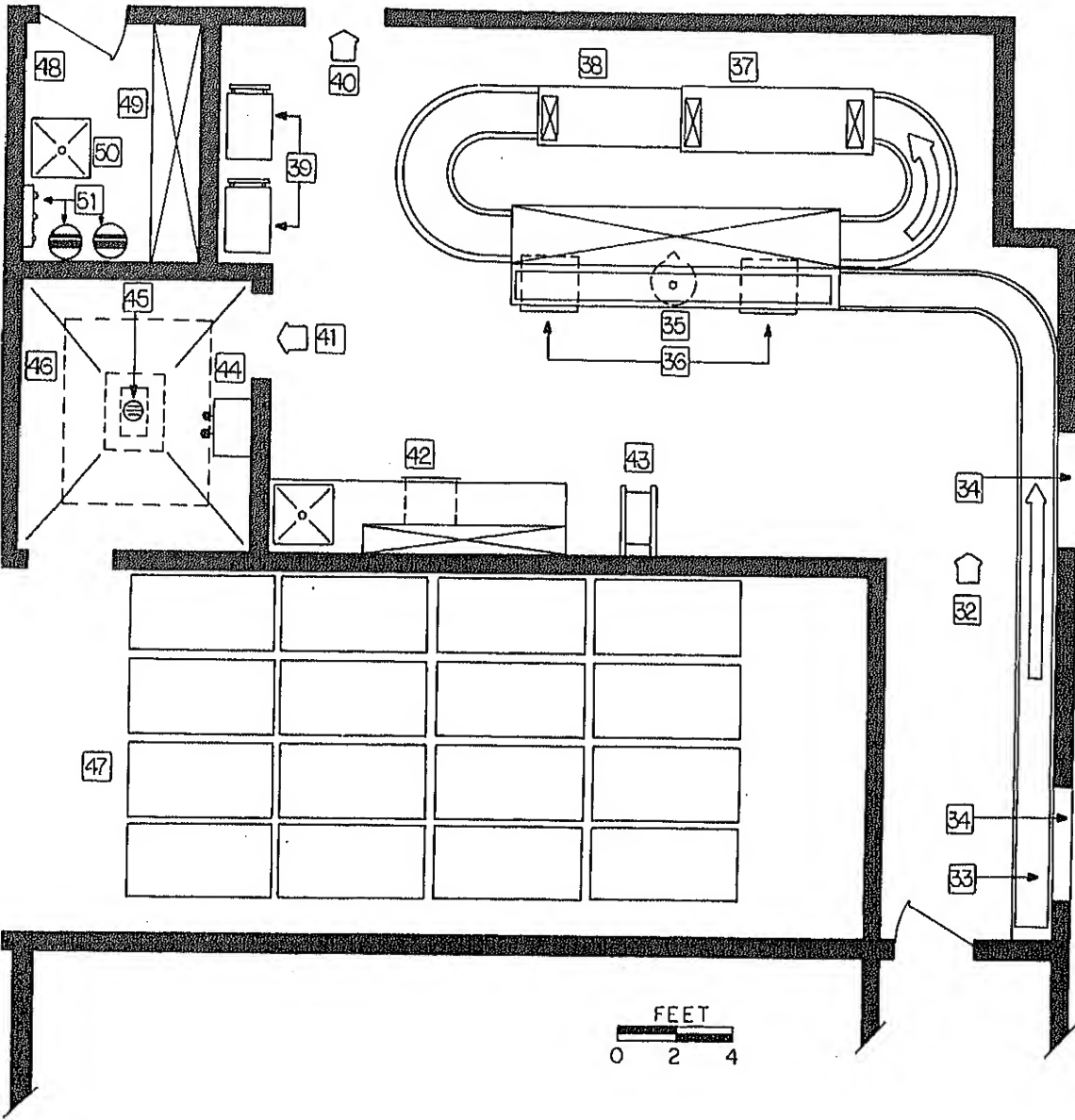


Figure 7.— Ready-food kitchen subsystem B' for a 300-bed hospital.

Facilities Schedule

1. Dry goods storage
2. Freezer storage
3. Cooler storage
4. Ingredient room
5. Nourishments
6. Pot- and pan-washing
7. Hot-food production
8. Food production office
9. Janitor's closet
10. Cold-food production
11. Cafeteria serving line
12. Packaging and freezing
13. General offices
14. Patient-tray assembly
15. Holding walk-in freezer
16. Cart-washing
17. Dishwashing
18. Clean-cart storage
19. Cafeteria seating
20. Director's office
21. Incoming goods flow
22. Issued goods flow from ingredient room and storeroom
23. Packaged, frozen-product flow to holding freezer
24. Tempered-product flow to patient-tray assembly
25. Tempered-product flow to cafeteria serving line
26. Cold-product flow through patient-tray assembly
27. Cold-product flow to cafeteria serving line
28. Assembled patient-tray flow
29. Employee entrance
30. Soiled patient-tray flow
31. Clean-dish and tray flow to patient-tray assembly
32. Clean-dish and tray flow to cafeteria serving line
33. Clean-tray and silverware flow
34. Replenishment flow for customer condiment station
35. Customer entrance
36. Customer exit to cafeteria seating
37. Emergency exits (2)
38. Soiled cafeteria-tray flow
39. Cafeteria exit

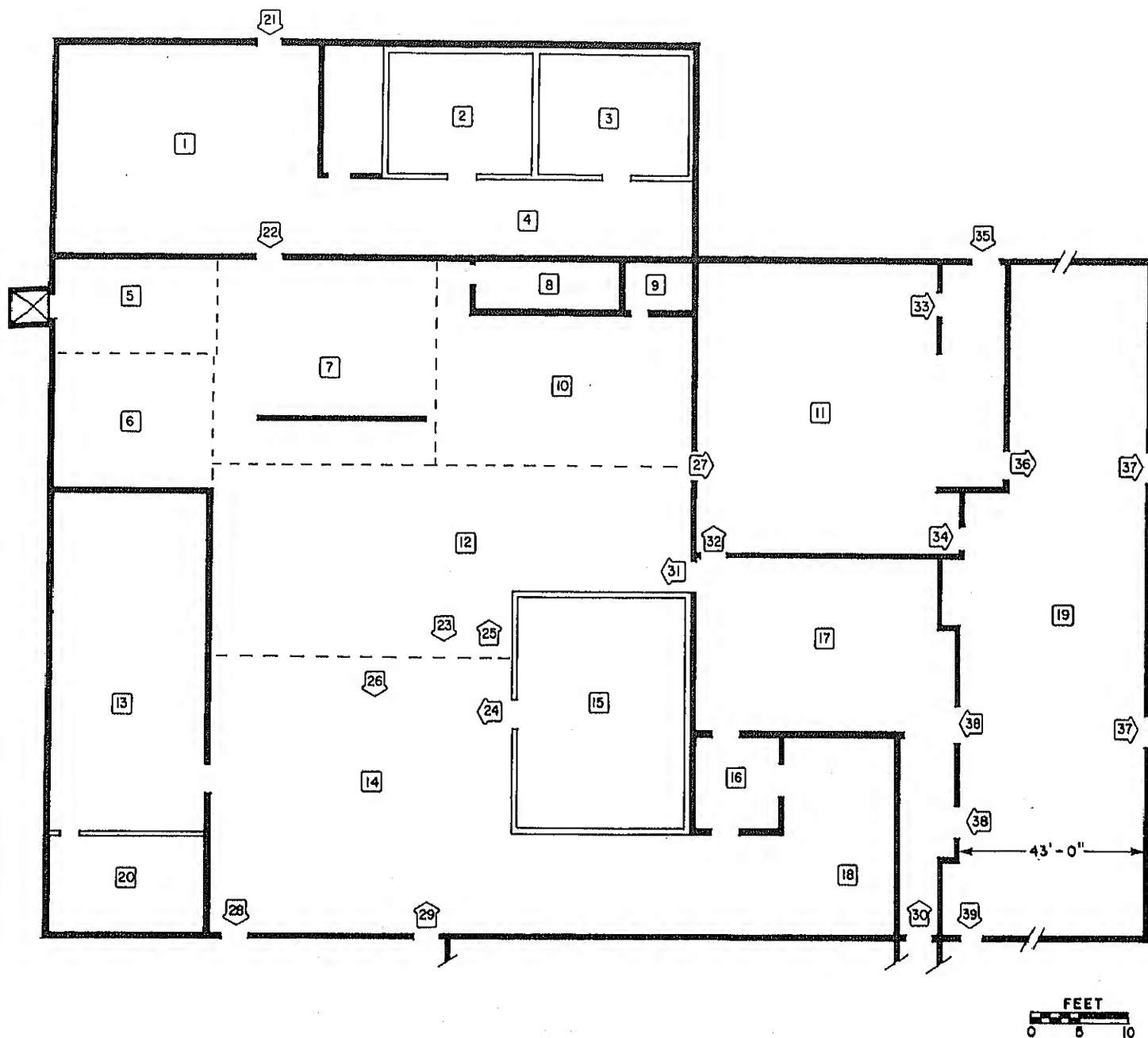


Figure 7 shows hot-food production, item 7, located between the storeroom operation, item 1, and the packaging and freezing operation, items 12 and 15, to facilitate food flow. The cafeteria operation, item 11, receives frozen products from the packaging and freezing operation. This product flow is indicated by item 27. The details of equipment location for the food production operation 310 are shown in figure 4, items 10 through 49, with the exception that locations of hot-food production, items 19 through 33, have been exchanged with cold-food production, items 37 through 41. Since fewer menu items are produced each day in greater quantities in a ready-food subsystem than in conventional subsystems, the following equipment items should be changed in figure 4 for hot-food production: delete items 26 and 27 and replace with two floor-model convection ovens with roll-in racks, and change item 30 to 30-gallon trunion kettles.

The location of equipment shown in figure 5 for the cafeteria is the same for both a conventional-food, a ready-food, and a convenience-food subsystem, with one exception. The hot food that passes through the window located between items 1 and 2 is deleted for ready-food and convenience-food cafeterias. A deck convection oven is placed in this location for these cafeteria operations.

Figure 8 shows equipment location for the manual pot-washing operation. Manual pot-washing is recommended for the ready-food kitchen subsystem and the convenience-food kitchen subsystem as the volume of soiled pots and pans is less than that of a conventional-food kitchen subsystem.

Figure 9 shows equipment location for the packaging and freezing operation, items 1 through 8, and the chill-plate tray-assembly operation, items 9 through 29. Two options offered by both the ready-food kitchen subsystem and the convenience-food subsystem are to deliver hot food directly to the patient or cold food to the patient's floor where it is reheated prior to delivery. Figure 1 illustrates these options. Ready-food kitchen subsystem B' and convenience-food kitchen subsystem C', which deliver hot food directly to patients, use tray-assembly operation 700. Equipment location for operation 700 is shown in figure 6, items 1 through 31. A deck convection oven would be located adjacent to the tempering boxes, item 8 in figure 10, to reheat food. Ready-food kitchen subsystem B and convenience-

food kitchen subsystem C, which deliver cold kitchen food to floor pantries for reheating, use tray-assembly operation for 710. Equipment locations for operation 710 are shown in figure 9.

Convenience-Food Kitchen Subsystem

The convenience-food kitchen subsystem has no on-premise cooking of foods. Entree items are purchased from outside vendors in preportioned or bulk form, and cold foods, such as salads, are prepared on the premises.

There are several advantages of the convenience-food kitchen subsystem. Fewer highly skilled personnel, such as chefs and cooks, are required. Less capital expenditure is required for food production equipment in the kitchen, such as ovens and griddles.

A disadvantage of the convenience-food kitchen subsystem is that management relinquishes control of product formulation and must accept the manufacturer's standards. Another inherent weakness is the inability to purchase a variety of menu items. Many modified diet entree items create an additional purchasing problem as some local suppliers are unwilling to stock them.

Figure 10 shows the location of operations for convenience-food kitchen subsystem C for a 300-bed hospital. The figure also shows the locations of dishwashing, item 11, and cart washing, item 10. These operations are a part of tray delivery and sanitation subsystems, which will be discussed elsewhere in this report.

Convenience-food kitchen subsystem C shown in figure 10 is comparable to the ready-food kitchen subsystem B' shown in figure 7, with the following exceptions: storeroom operation, item 1 and nourishment and late-tray assembly, item 7, have been relocated; and the hot-food production and packaging and freezing operation have been deleted. The location of equipment for this subsystem is shown in figures 3 through 6, 8, and 9.

Least-Cost Kitchen Subsystem

Ready-food kitchen subsystem B was selected as the least-cost kitchen subsystem. Subsystem B requires less worker-hours than subsystem A for all hospital bed sizes, and is less expensive for hospitals under 430 beds. Subsystem B is less expensive than subsystem C for all hospital bed sizes.

Figure 8.—Manual pot-washing operation.

Equipment Schedule

1. Clean pot- and pan-storage racks (3)
2. Overhead spray-rinse arms (2)
3. Stainless steel pot and pan sinks (3)
4. Garbage disposal
5. Solled landing table/skate-wheel conveyor

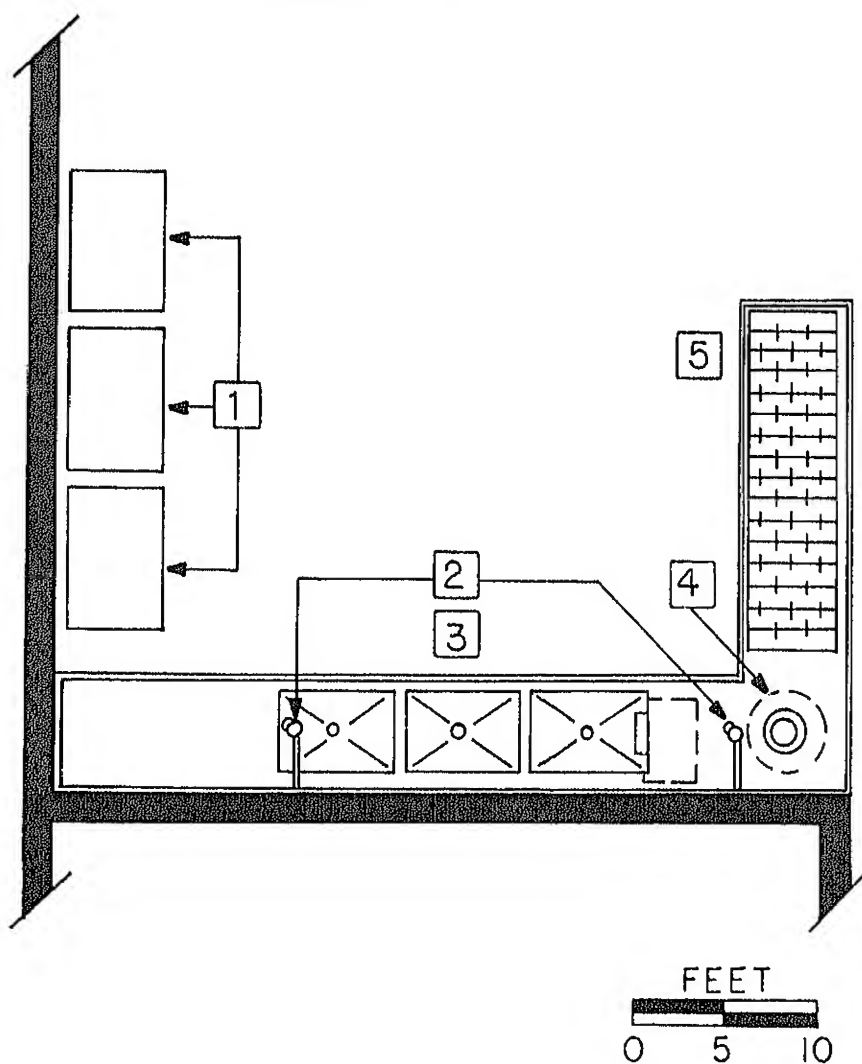


Figure 9.—Packaging and freezing, and chill-plate tray-assembly operations.

Equipment Schedule

- | | |
|---|--|
| 1. Stainless steel table/overshelf, undershelf and drawer | 17. Overhead diet-kit rack |
| 2. Lid-sealing machine/roller | 18. Pass-through rack cooler |
| 3. Mobile freezer racks (6) | 19. Mobile dessert and salad racks (4) |
| 4. Chill boxes (5) | 20. Soup wells (2) |
| 5. Blast freezers (3) | 21. Soup-bowl dispenser |
| 6. Tempering boxes (3) | 22. Cold-beverage cabinet |
| 7. Holding walk-in freezer/inclined pan racks (3) | 23. Cold-beverage table/inclined overshelf |
| 8. Tempering boxes (3) | 24. Cold-beverage cabinet |
| 9. Starter position | 25. Roller conveyor |
| 10. Salad and dessert position | 26. Plate dispenser |
| 11. Soup position | 27. Cold-entree wells (8) |
| 12. Cold-beverage position | 28. Checker table/inclined plate-cover overshelf |
| 13. Cold-entree position | 29. Patient-tray delivery flow |
| 14. Checker-loader position | 30. Timecard rack |
| 15. Condiment table | 31. Timeclock |
| 16. Tray-dispensing rack | |

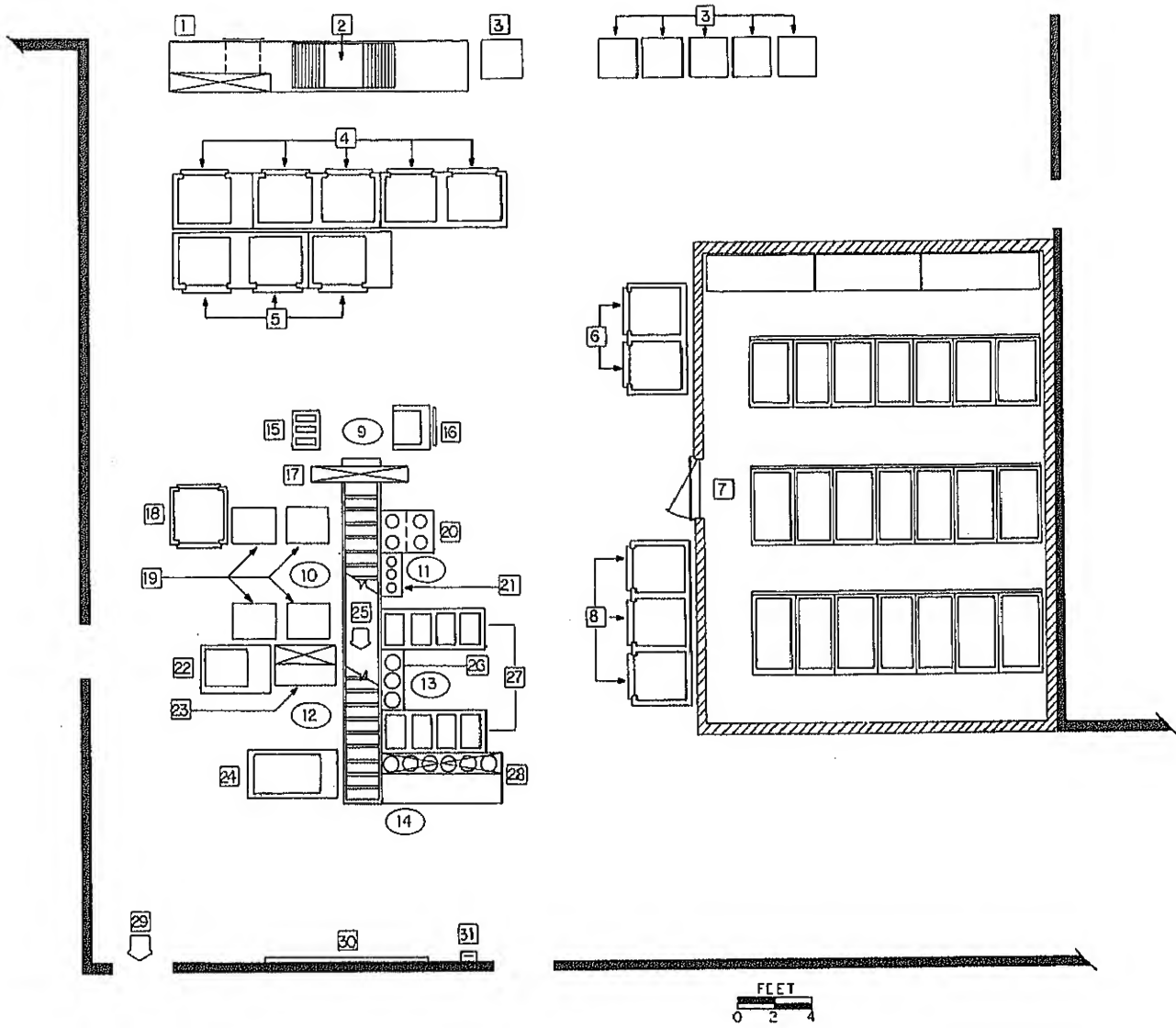


Figure 10.—Convenience-food kitchen subsystem C for a 300-bed hospital.

Facilities Schedule

- | | |
|--|---|
| 1. Dry goods storage | 17. Finished cold-products flow to cafeteria serving line |
| 2. Freezer storage | 18. Finished cold-products flow to patient-tray assembly |
| 3. Cooler storage | 19. Assembled patient-tray flow |
| 4. Cold-food production | 20. Employee entrance |
| 5. General offices | 21. Served patient-tray flow |
| 6. Pot-washing | 22. Clean dish-return flow to patient-tray assembly |
| 7. Nourishments and late-tray assembly | 23. Clean dish-return flow to cafeteria serving line |
| 8. Patient-tray assembly | 24. Served-cart flow |
| 9. Janitor's closet | 25. Cafeteria line entrance |
| 10. Cart-washing | 26. Cafeteria line exit |
| 11. Dishwashing | 27. Replenishment flow to condiment station |
| 12. Clean-cart storage | 28. Emergency exits (2) |
| 13. Cafeteria serving line | 29. Served dish-return flow from cafeteria |
| 14. Cafeteria seating | 30. Cafeteria customer exit |
| 15. Incoming goods flow | 31. Clean-tray and silverware flow to tray station |
| 16. Issued goods from storeroom flow | |

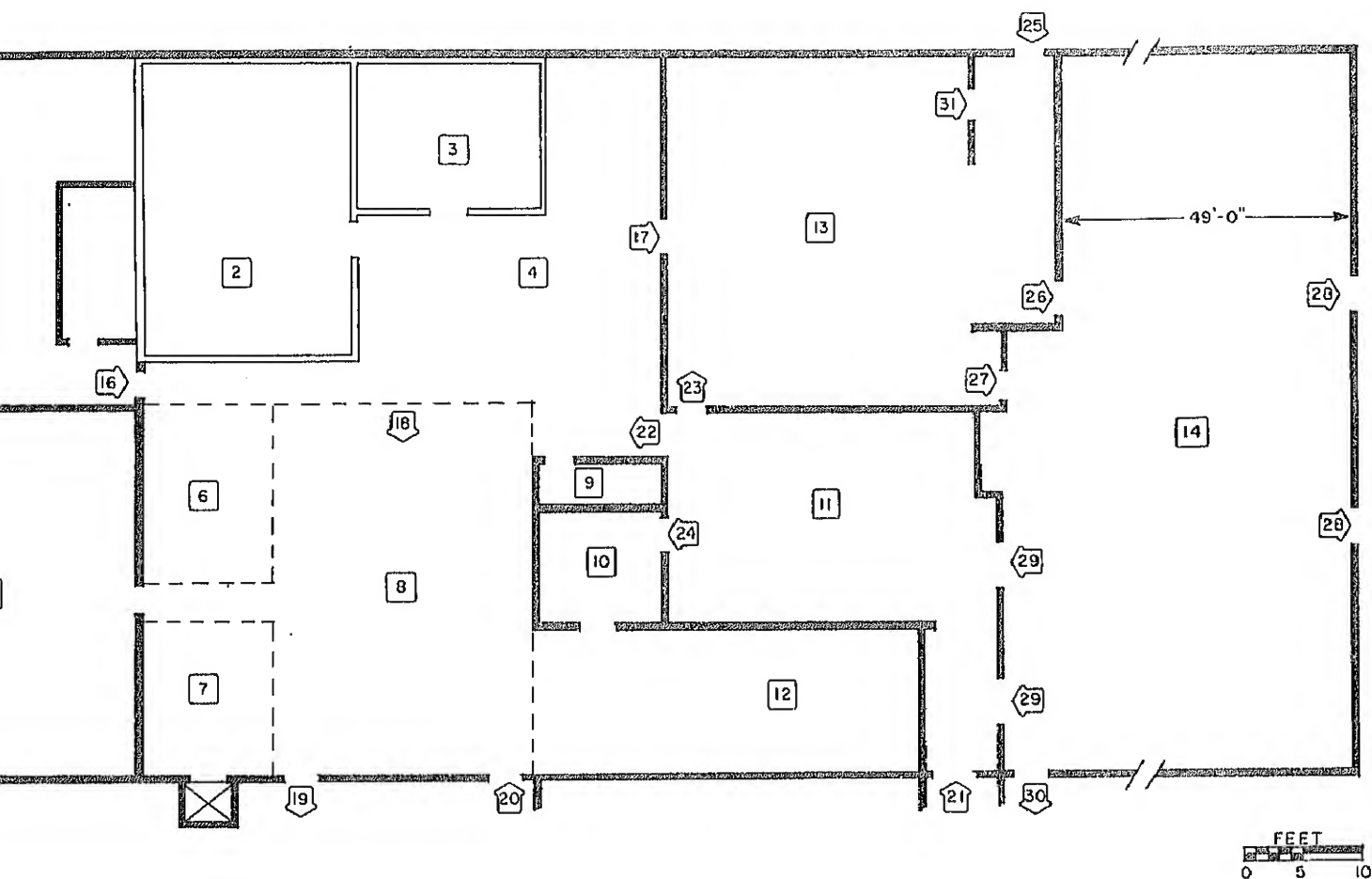


Table 6 shows potential annual worker-hours and dollar-cost savings of subsystem B versus subsystem A, and subsystem B versus subsystem C by hospital bed size.⁹ Inspection of the linear regression data shown in table 3 shows subsystems B and B' are approximately the same, as are subsystems C and C'. Therefore, the potential annual savings of subsystems B' and C' were not analyzed.

Table 6 shows that subsystem B requires less worker-hours per year than subsystem A for all hospital bed

Table 6.—Potential dollar cost and worker-hour year of subsystem B versus subsystems A and C.

Hospital bed size Number	Annual savings			
	Subsystem B versus			
	Subsystem A		Subsystem C	
	Time	Cost	Time	Cost
	Hours	Dollars	Hours	Dollars
100	3,600	13,500	-4,200	47,600
200	4,400	9,400	-5,200	123,100
300	5,100	5,300	-6,200	198,500
400	5,800	1,100	-7,200	274,000
500	6,600	-3,000	-8,200	349,500
600	7,300	-7,100	-9,300	425,000

sizes. The worker-hour savings increase as hospital bed size increases. The table also shows that subsystem B is less expensive to operate per year than subsystem A in hospitals with 400 or fewer beds. The dollar-cost savings decrease as hospital bed size increases. The operating costs for subsystems B and A are approximately equal in 430-bed size hospitals.¹⁰ Subsystem B is more expensive than subsystem A in hospitals over 430 beds, as a result of expenses incurred for operation 600, packaging and freezing. Approximately 75 percent of the variable packaging and freezing cost is for multiportioned aluminum pans (\$635.808 pan cost per 100 beds ÷ \$845.639 total cost per 100 beds). If the cost of using multiportioned pans could be reduced to \$200 by using the pans for freezing cycles instead of one and by selling the used pans for scrap value, the overall cost of subsystem B would be reduced to $Y = 23,417.052X + 4,167.47$. In this event, subsystem B would be less expensive than subsystem A for hospitals from 100 to 600 beds.

Table 6 shows that subsystem B requires more worker-hours per year (negative worker-hour savings) than subsystem C. Subsystem B requires more worker-hours than subsystem C as hospital bed size increases. However, the table shows that subsystem B is less expensive per year to operate than subsystem C. The dollar-cost savings increase as hospital bed size increases. The cost savings result primarily from the increased material costs of convenience-food production operation 310. The operating costs for subsystems B and C are approximately equal in 40-bed size hospitals.¹¹

⁹ Savings formulas were computed by subtracting standard time and cost formulas by subsystem shown in table 3. For example, the time-saving formula for subsystem B versus subsystem A was computed as follows:

$$Y_a = 1,788.38X + 964.93$$

$$- Y_b = -1,717.42X - 772.03$$

$$Y \text{ savings per month} = 60.96 \times + 242.90$$

where Y_a is cost per month for subsystem A,

Y_b is cost per month for subsystem B, and

X is hundreds of patient beds.

¹⁰ Intersections were computed by equating standard time and cost formulas by subsystem shown in table 3. For example, the intersection of the cost functions for subsystems B and A was computed as follows:

$$23,509.04X + 5,633.83 = 23,852.86X + 4,164.47$$

$$343.82X + 1,469.36$$

$$X = 4.27 \text{ (430 beds)}$$

¹¹ Ibid.

Based on the observed work methods and the equipment used in the participating hospitals, subsystem B has a greater potential for reducing labor requirements and operating costs than subsystem A. The impact of the following items on subsystem B and subsystem A should be researched to determine the extent of their savings.

1. Change existing 14-day cycle to a 1-day restaurant-type menu.
2. Produce such items as salads, sandwiches, and in-house desserts for more than 1 day's requirements.
3. Install semiautomated batch-measuring devices for such items as flour, sugar, oil, purity 69, and water in appropriate food production departments.
4. Determine the feasibility of obtaining frozen vegetables and frozen preportioned meat items such as liver, cutlets, and meat patties ready for rethermalization at a floor pantry.
5. Develop improved low-cost bulk filling and container-sealing equipment.
6. Determine the feasibility of bulk-packaging ready foods in less expensive containers than aluminum.

In addition, research should be conducted in hospitals under 40 beds to verify that subsystem C is less expensive than subsystem B.

Tray Delivery and Sanitation Subsystems

Eight types of tray delivery and sanitation subsystems were studied in this research. Figure 11 shows the component operations of the tray delivery and sanitation subsystems which were identified by numerals 1 through 8. Tray delivery and sanitation subsystems 1 through 4 may be used in combination with kitchen subsystems A, B, and C when food is delivered hot from the tray-assembly line. Tray delivery and sanitation subsystems 5 through 8 may be used in combination with kitchen subsystems B and C when food is delivered cold to floor pantries from a chill-plate tray-assembly line. Tray delivery carts were manually transported in the eight subsystems. A reserved service elevator was used to transport carts between the ground-floor kitchen to the next patient-floor level containing 100 beds and four floor pantries. Labor costs and labor hours to deliver bulk supplemental feedings to floor pantries and individual supplemental feedings from floor pantries to patients are included in each tray delivery operation.

The location of equipment for dishwashing operations shown in figure 6, items 32 through 40, are typical of subsystems 2, 3, 5, 7, and 8. The equipment requirements for subsystems 1, 4, and 6, which use single-service ware, would be changed by replacing the carousel-type dish machine with a rack-type machine, eliminating the silver-sorting station, and adding trash receptacles for single-service ware.

Figure 11 shows that manual cart-washing operations were used for the eight tray delivery and sanitation subsystems. The equipment location for manual cart-washing operations is shown in figure 6, items 44 through 46. Manual cart-washing operations were used, as opposed to machine cart-washing operations, as they are less expensive in hospitals under 600 beds. Table 7 shows the potential annual savings of manual cart-washing operations over machine cart-washing operations.¹²

Table 7.—Potential annual savings of manual versus machine cart-washing operations.

Hospital bed size	Annual savings by operation code ¹		
	1001 versus 1011	1002 versus 1012	1003 versus 1013
Number	Dollars	Dollars	Dollars
100	1,430	1,400	1,860
200	1,190	1,130	2,040
300	940	870	2,220
400	700	600	2,400
500	450	330	2,580
600	210	60	2,760

¹ See appendix A for explanation of codes.

¹² Same as footnote 9.

Hot-Food Tray Delivery and Sanitation Subsystems

Tray delivery and sanitation subsystems 1 through 4 use conventional pantry-tray delivery operation 801. The details of equipment location for operation 801 are shown in figure 12. The conventional-floor pantry is used primarily to assemble between-meal supplemental feeding trays for patients.

Subsystem number 1 delivers hot food plated on single-service ware directly to patients. This type of subsystem uses an insulated plastic-bottomed tray and an insulated plastic-topped tray cover to maintain food temperatures. The trays are transported on open carts. After all meals have been delivered and consumed, the soiled single-service ware and carts are returned to dishwashing operation 920. Single-service ware is removed from trays and transported to the trash pickup area, where it is compacted. The insulated trays and covers are processed through the dish machine and returned to the tray-assembly operation. The open carts are washed in cart-washing operation number 1003 and returned to the cart storage area.

Subsystem number 2 delivers hot food plated on permanent ware directly to patients. This type of subsystem uses a split or divided tray. Cold foods are plated on one side of the tray and hot foods are plated on the opposite side. The trays are transported in closed

carts which have self-contained refrigeration and heating capability to maintain food temperatures. The cart is left on the patient floor while meals are being consumed, is loaded with soiled trays and permanent ware, and returned to split-tray or chill-plate dishwashing operation 910. The closed carts are washed in cart-washing operation 2002.

Subsystem number 3 delivers hot food plated on permanent ware directly to patients. This type of subsystem uses a one-piece tray. The temperature of the hot food is maintained by placing the permanent-ware plate on a heated, circular, stainless-steel base and covering the base and plate with a stainless-steel cover. The trays are transported in closed carts to and from the patients in the same manner as subsystem 2. Operations 900 and 1001 are used to process soiled permanent ware, trays, and carts.

Subsystem number 4 delivers hot food plated on single-service ware to patients. This type of subsystem uses a one-piece permanent-ware tray. The temperature of the hot food is maintained by placing a single-service cover over the plate containing hot food. The trays are transported to and from the patients in the same manner as subsystem 1. Operations 940 and 1001 are used to process soiled trays and carts.

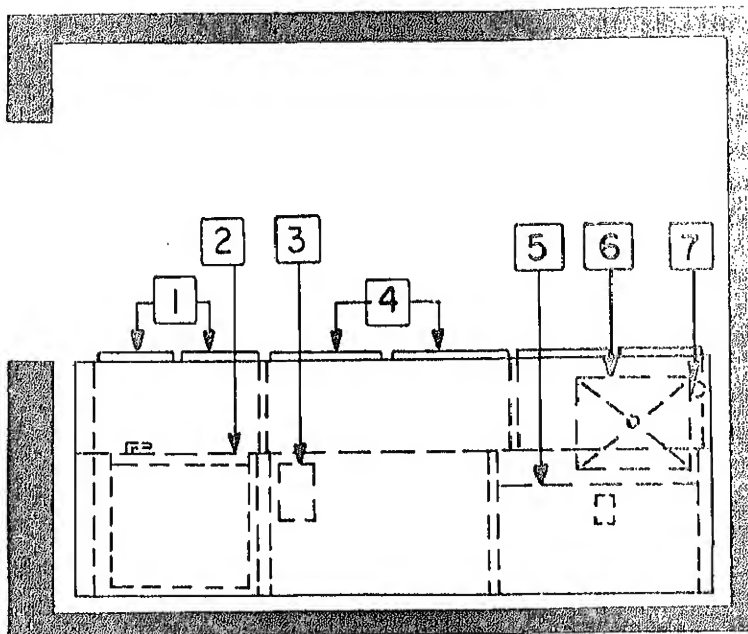
Figure 11.—Operation components of tray delivery and sanitation subsystems.

Operation Code	Operation description	Tray delivery and sanitation subsystem components							
		Hot food				Cold food			
		1	2	3	4	5	6	7	8
801	Conventional pantry, tray delivery	X	X	X	X				
803	Microwave pantry, tray delivery					X	X		
805	Convection pantry, tray delivery							X	
806	Integral-heat pantry, tray delivery								X
900	Pellet base, dishwashing			X					
910	Split tray or chill plate, dishwashing		X			X		X	
920	Single-service insulated-tray dishwashing	X							
930	Integral-heat, dishwashing								X
940	Single-service dishwashing				X		X		
1001	Manual closed cart-washing			X	X	X	X	X	X
1002	Manual hot-cold, cart-washing		X						
1003	Manual open cart-washing	X							

Figure 12.—Conventional-floor pantry.

Equipment Schedule

1. Storage compartment
2. Microwave oven on shelf
3. Coffee dispenser on shelf
4. Dual cooler and freezer
5. Ice dispenser
6. Sink
7. Hot water dispenser



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0 1 2

Least-Cost Hot-Food Tray Delivery and Sanitation Subsystems

Subsystem 2 was selected as the least-cost hot-food tray delivery subsystem. Subsystem 2 is less expensive to operate annually than subsystems 1, 3, or 4 in hospitals from 100 to 600 beds. The research data indicate that subsystems using single-service ware (subsystems 1 and 4) can be operated at the same or less expense in hospitals under 100 beds. Additional research should be conducted in these hospitals to verify potential cost savings of single-service ware. (Hospitals under 100 beds were not analyzed in this research.) In addition, the research findings show single-service tray delivery and sanitation subsystem 4 has substantial labor-time savings over the other subsystems, even though it is more expensive to operate. Hospitals which experience difficulty in retaining personnel in the less desirable tray-delivery and dishwashing operations could possibly offset the increased cost of subsystem 4 by reduced costs for employee turnover.

Table 8 shows the potential annual labor-time and dollar-cost savings of subsystem 2 versus subsystem 1, subsystem 2 versus subsystem 3, and subsystem 2 versus subsystem 4 by hospital bed size.¹³

The table shows that subsystem 2 requires more worker-hours than subsystems 1 and 4 (as indicated by the negative numbers), and requires less worker-hours than subsystem number 3. Subsystem 2 is less expensive to operate per year than subsystem 1, 3, or 4. The negative worker-hour savings and positive dollar-cost savings increase as hospital bed size increases. The

Table 8.—Potential annual labor-time cost and dollar-cost savings of subsystems 2 versus subsystems 1, 3, and 4.

Hospital bed size	Subsystem 2 versus-					
	Subsystem 1		Subsystem 3		Subsystem 4	
	Time	Cost	Time	Cost	Time	Cost
Number	Hours	Dollars	Hours	Dollars	Hours	Dollars
100	-2,800	7,400	300	1,800	-3,000	4,500
200	-4,700	18,700	500	3,600	-5,000	13,000
300	-6,600	30,000	800	5,300	-7,000	21,500
400	-8,500	41,300	1,000	7,100	-9,400	30,000
500	-10,000	52,600	1,300	8,800	-11,600	38,500
600	-12,300	63,900	1,600	10,600	-13,800	46,900

operating costs of subsystems 2 and 1 are equal at 35 beds.¹⁴ The operating costs of subsystems 2 and 4 are equal at 40 beds.

Cold-Food Tray Delivery and Sanitation Subsystems

Cold-food tray delivery and sanitation subsystems 5 through 8 use a decentralized floor pantry equipped with ovens to reheat food which has been delivered cold from the tray-assembly line in closed carts. The details of equipment location for the decentralized floor pantry using a convection oven are shown in figure 13. The locations of equipment in the decentralized floor pantries for operations 803 and 806 are similar with the exception of item 8, convection oven, which is replaced with a microwave oven for operation 803 and an integral heat cabinet for operation 806.

Subsystem 5 delivers hot food to patients on permanent ware from microwave pantry-tray delivery operation 803. Two meals per batch are reheated in a microwave oven. Hot beverages and toast are placed on the tray during the oven cycle. After consumption of the food, soiled dishware and carts are processed through operations 910 and 1001. Subsystem 6 is comparable to subsystem 5, except that single-service ware is used. Soiled trays, single-service ware, and carts are processed in operations 940 and 1001.

Subsystem 7 is also comparable to subsystem number 5, except that patient meals are reheated in a convection oven. Twelve patient meals per batch are reheated. The microwave oven, item 2 in figure 12, is used to reheat either early or late trays. Soiled trays, permanent ware, and carts are processed in operations 910 and 1001.

Subsystem 8 delivers hot food to patients on an integral-heat dish which reheats food in a cabinet. The integral-heat dish has a thermostat-controlled heating element mounted between a plastic outer shell and a ceramic dish. Electrical energy is provided to the heating element from rails in the reheating cabinet through contacts on the lip of the dish's outer shell. Each dish has a plastic cover. Twenty patient meals per batch are reheated in a cabinet. After consumption of the food, soiled dishes and carts are processed through operations 930 and 1001.

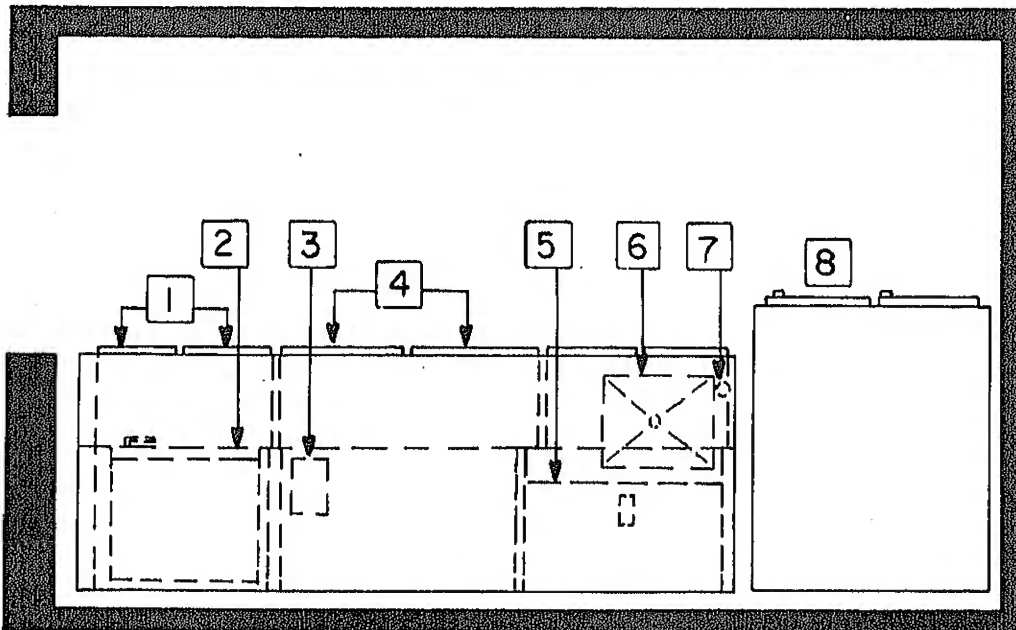
¹³ Same as footnote 9.

¹⁴ Same as footnote 10.

Figure 13.—Decentralized floor pantry.

Equipment Schedule

1. Storage compartment
2. Microwave oven on shelf
3. Coffee dispenser on shelf
4. Dual cooler and freezer
5. Ice dispenser
6. Sink
7. Hot water dispenser
8. Convection oven on cooler base



Least-Cost Cold-Food Tray Delivery and Sanitation Subsystems

Subsystem 7 was selected as the least-cost cold-food tray delivery subsystem. It offers substantial annual cost savings over subsystems 5, 6, and 8. Subsystem 7 offers moderate annual worker-hour savings over subsystem 8, and substantial annual worker-hour savings over subsystems 5 and 6. Research data show that the costs of operating subsystems 6 and 7 are equal at 26 beds.¹⁵ Subsystem 6 is less expensive than subsystem 7 in hospitals under 26 beds. Additional research should be conducted in hospitals under 100 beds to verify the potential cost savings of subsystem 6 over subsystem 7. (Hospitals under 100 beds were not analyzed in this research.)

Table 9 shows the potential annual worker-hour and dollar-cost savings of subsystem 7 versus subsystems 5, 6, and 8.¹⁶ The table shows that annual savings increase as the number of hospital beds increases for all subsystems.

¹⁵ Same as footnote 10.

¹⁶ Same as footnote 9.

Table 9.—Annual worker-hour and dollar-cost savings of subsystem 7 versus subsystems 5, 6, and 8.

Hospital bed size	Subsystem 7 versus-					
	Subsystem 5		Subsystem 6		Subsystem 8	
	Time	Cost	Time	Cost	Time	Cost
Number	Hours	Dollars	Hours	Dollars	Hours	Dollars
100	5,300	22,100	2,300	27,200	300	19,800
200	10,600	44,100	5,500	58,200	500	39,400
300	15,900	66,200	8,600	89,300	800	59,100
400	21,200	88,300	11,800	120,300	1,000	78,700
500	26,500	110,300	14,900	151,400	1,300	98,300
600	31,800	132,400	18,100	182,400	1,600	117,900

Least-Cost System

System B-2 was selected as the least-cost system. System B-2 is the combination of ready-food kitchen subsystem B and hot-food tray delivery and sanitation subsystem 2. The component operations of all systems are shown in figures 1 and 11. System B-2 is less expensive to operate than the other systems analyzed in this research, with the exception of system A-2. System A-2 is less expensive than system B-2 in hospitals over 430 beds. System B-2 requires fewer worker-hours than systems A-2, A-3, B-3, B-5, B-6, B-7, B-8, C-5, and C-8 for all hospital sizes.

Table 10 shows the annual cost savings of system B-2 over all other systems analyzed.¹⁷ This research shows that system B-2 is more expensive than system A-2 in hospitals over 430 beds, and is more expensive than system A-4 in hospitals over 750 beds.¹⁸

Table 11 shows the annual worker-hour savings of system B-2 over all other systems analyzed in this research. The table shows system B-2 requires fewer worker-hours than systems A-1, A-2, A-3, B-3, B-5 through B-8, C-5, and C-8. System B-2 requires fewer

Table 10.—Potential annual cost savings of system B-2 versus all other systems.

System B-2 versus system	Annual cost savings by hospital bed size					
	100	200	300	400	500	600
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
A-1	20,800	28,000	35,200	42,400	49,600	56,800
A-2	13,500	9,300	5,200	1,100	-3,000	-7,200
A-3	15,600	13,300	10,900	8,500	6,200	3,800
A-4	18,000	22,400	26,700	31,100	35,400	39,800
B-1	7,400	18,700	30,000	41,300	52,600	63,900
B-3	1,800	3,600	5,300	7,100	8,800	10,600
B-4	4,500	13,000	21,500	30,000	38,500	46,900
B-5	39,100	76,800	114,000	151,500	188,900	226,400
B-6	44,200	90,600	137,100	183,500	230,000	276,400
B-7	17,100	32,500	47,800	63,200	78,600	94,000
B-8	36,900	71,900	106,900	141,900	176,900	211,900
C-1	54,900	141,700	228,500	351,300	402,100	488,900
C-2	47,500	123,100	198,500	274,000	349,500	425,100
C-3	49,900	126,600	203,900	281,100	358,300	435,600
C-4	52,100	136,000	220,000	304,000	387,900	471,900
C-5	86,700	199,600	312,600	425,500	538,000	651,300
C-6	91,700	213,700	335,600	457,500	579,500	701,400
C-7	64,600	155,500	246,400	337,200	428,100	519,000
C-8	84,400	194,900	305,400	415,900	526,400	636,900

worker-hours than system A-1 in hospitals under 280 beds and fewer worker-hours than system A-4 in the hospitals under 150 beds. System B-2 requires more worker-hours than system C-5 in hospitals under 40 beds, more worker-hours than system C-6 in hospitals under 80 beds, and more worker-hours than systems C-7 and C-8 in hospitals under 130 beds. System B-2 requires more worker-hours than system B-1, B-4, and C-1 through C-4.

Estimating Costs of Alternative Food Service Systems

The data presented in this report may be used by food service directors and hospital administrators as a tool in comparing costs of alternative systems for new hospital construction. It may also be used to compare costs of an existing system and an alternative system for hospital expansion or remodeling. As previously stated in this report, the data should not be used as a management tool in a specific hospital to develop labor schedules or department budgets.

¹² See footnote 9.

¹³ See footnote 10.

Table 11.—Potential annual worker-hour savings of system B-2 versus all other systems.

System B-2 versus system	Annual cost savings by hospital bed size					
	100	200	300	400	500	600
	Hours	Hours	Hours	Hours	Hours	Hours
A-1	900	-300	-1,500	-2,600	-3,800	-5,000
A-2	3,600	4,400	5,100	5,800	6,600	7,300
A-3	3,900	4,900	5,900	6,900	7,900	8,900
A-4	700	-800	-2,200	-3,600	-5,000	-6,400
B-1	-2,700	-4,700	-6,600	-8,500	-10,400	-12,300
B-3	300	500	800	1,000	1,300	1,600
B-4	-3,000	-5,100	-7,300	-9,400	-11,600	-13,700
B-5	8,500	17,000	25,400	33,900	42,400	50,900
B-6	5,500	11,800	18,200	24,500	30,800	37,100
B-7	3,200	6,400	9,500	12,700	15,900	19,100
B-8	3,400	6,900	10,300	13,700	17,200	20,600
C-1	-6,900	-9,900	-12,800	-15,700	-18,600	-21,500
C-2	-4,200	-5,200	-6,200	-7,200	-8,200	-9,300
C-3	-3,900	-4,700	-5,400	-6,200	-6,900	-7,700
C-4	-7,200	-10,300	-13,500	-16,700	-19,800	-23,000
C-5	4,300	11,800	19,200	26,700	34,200	41,600
C-6	1,300	6,600	11,900	17,300	22,600	27,900
C-7	-1,000	1,200	3,300	5,500	7,600	9,800
C-8	-700	1,700	4,100	6,500	8,900	11,400

The data shown in table 12, listing of standard linear equations by type of operation, will be used to compare system costs in new construction and hospital expansion in the following examples. Although only two systems are analyzed in each example, the same methods should be applied in cost comparisons of other systems.

System Costs For New Construction

In this example, the hospital administrator has requested the food service director to prepare an economic feasibility study of a conventional versus a ready-food system for a 350-bed general hospital. Based on survey information supplied to the board of regents and the hospital administrator, it will be difficult to recruit part-time labor, and availability of convenience-food suppliers is limited. The hospital will be located in a high-wage cost area. Both systems will use single-service operations based on these labor market factors.

The following steps should be followed by the food service director to determine costs for each system:

1. Determine and list the operations of each system.
2. List the standard linear time equations of the operations for each system determined in step 1. Linear time equations are shown in table 12.
3. Determine and record the adjusted average hourly wage rate for each operation. The adjusted wage rate is defined as actual hourly wage rate plus fringe benefits. Fringe benefits are defined as dollar costs for such items as insurance, retirement, social security, unemployment and workers' compensation, parking, and educational assistance.
4. Compute the adjusted labor hours, adjusted FTE's (full-time equivalent employees), and adjusted labor costs for each operation. Add adjusted labor hours, adjusted FTE's, and adjusted labor costs for each system. Adjusted labor hours per month are defined as the standard labor hours per month multiplied by a vacation-sick leave time factor. The vacation-sick leave time factor is calculated by dividing 260 working days per employee year (52 weeks × 5 days per week) by 260 working days, less vacation and sick-leave days. Adjusted FTE's are defined as adjusted labor hours per month divided by 173.33 hours (260 working days per year × 8 working hours per day divided by 12 months per year). Adjusted labor costs are defined as adjusted labor rate per hour multiplied by adjusted labor time.
5. Add the standard material and services cost equa-

Table 12.—Listing of standard linear equations by operation type.

Code	Operation	Labor time		Labor cost		Material and services cost		Overhead cost	
		Slope (a)	Intercept (b)	Slope (a)	Intercept (b)	Slope (a)	Intercept (b)	Slope (a)	Intercept (b)
		Hours	Hours	Dollars	Dollars	Dollars	Dollars	Dollars ¹	Dollars
100	Management	1,105.11	-790.32	7,456.81	-5,186.25	—	—	316.21	32.58
200	Conventional storeroom	25.45	.02	108.33	—	—	—	108.75	67.60
210	Ready-food storeroom	25.45	.02	108.33	—	—	—	164.35	90.56
220	Convenience-food storeroom	25.45	.02	108.33	—	—	—	86.99	97.99
300	Conventional-food production	213.45	706.59	1,299.57	3,804.69	11,582.34	.09	173.71	971.85
310	Ready-food production	177.52	430.43	905.11	2,021.09	11,582.34	.09	173.71	971.85
320	Convenience-food production	98.08	183.16	452.00	835.19	19,376.67	—	45.27	171.39
400	Cafeteria	173.23	883.58	737.03	4,144.34	—	—	572.40	649.85
500	Conventional-food machine								
	pot-washing	32.26	.32	137.30	1.37	—	—	11.15	146.20
501	Ready-food machine								
	pot-washing	1.36	10.69	5.80	45.54	—	—	—	155.04
502	Convenience-food machine								
	pot-washing	.97	7.78	4.14	33.11	—	—	—	155.04
510	Conventional-manual								
	pot-washing	104.39	—	444.29	—	—	—	—	102.34
511	Ready-food manual								
	pot-washing	1.85	12.66	8.05	53.03	—	—	—	2
512	Convenience-food manual								
	pot-washing	2.14	17.09	9.10	72.75	—	—	—	2
600	Packaging and freezing	5.40	20.96	28.95	112.30	635.81	45.47	180.88	209.91
700	Hot-food tray-assembly	228.88	164.74	974.10	701.14	—	—	76.15	301.15
710	Chill-plate tray-assembly	228.86	164.70	974.10	701.14	—	—	48.94	295.52
801	Conventional-pantry tray								
	delivery	251.88	—	1,072.00	—	—	—	408.07	-150.55
803	Microwave-pantry tray								
	delivery	958.53	—	4,079.50	—	—	—	564.08	-8.34
805	Convection-pantry tray								
	delivery	516.53	—	2,198.53	—	—	—	606.74	-9.57
806	Permanent-ware Integral								
	heat-tray delivery	516.53	—	2,198.53	—	—	—	654.45	-8.44
900	Pellet-base dishwashing	306.65	68.62	1,305.10	292.03	1,104.35	73.34	91.74	129.17
910	Split-tray or chill-plate								
	dishwashing	285.10	68.44	1,213.42	291.23	1,006.72	68.28	91.74	129.17
920	Insulated-tray dishwashing	134.58	—	572.77	—	2,772.54	.80	22.73	159.84
930	Integral-heat dishwashing	306.65	68.62	1,305.10	292.03	2,508.52	72.92	91.74	129.17
940	Single-service dishwashing	105.59	—	449.38	.16	2,589.52	.80	22.73	159.84
1001	Manual closed-cart-washing	27.71	.57	117.97	2.22	—	—	70.72	55.43
1002	Manual hot-cold cart-washing	27.71	.57	117.97	2.22	—	—	112.02	55.43
1003	Manual open-cart-washing	19.04	-.59	80.61	1.75	—	—	35.31	55.66
1011	Machine closed-cart-washing	20.86	5.02	95.55	-15.76	—	—	70.72	212.99 ¹
1012	Machine hot-cold								
	cart-washing	20.86	5.02	95.55	-15.76	—	—	112.02	212.99
1013	Machine open-cart-washing	20.86	5.02	95.55	-15.76	—	—	35.35	212.99

¹ Linear equations expressed in terms of $Y = ax + b$, where x is hundreds of patient beds.

² From 100 through 300 beds, intercept is 31.51; from 400 through 800 beds, intercept is 48.45.

tions of the operations for each system described in step 1, and compute total standard-system cost and adjusted total system cost. Adjusted total material and services cost is the product of total material and services cost multiplied by the producer price index change from 1977. The producer price index for finished consumer food in 1977 was 189.2.¹⁹ This index is used to calculate the producer price index percentage change. Current producer price indices, printed monthly, may be obtained free of charge from the U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C. 20212 (telephones 202-523-1222, 523-1239, 523-1913, or 523-1208).

6. Add the standard overhead cost equations of the operations for each system described in step 1, and total cost and adjusted total cost. The adjusted total overhead cost is computed in the same manner as described in step 5, with the exception of using the producer price index of 152.2 for finished consumer durable goods in 1977.²⁰

7. Total adjusted costs for labor, material and services and overhead for each system developed in steps 4, 5, and 6.

Data in table 13 show computation results of the preceding 7-step method for comparing new construction estimates of a conventional-food service system versus a ready-food service system for a 350-bed general hospital. Step numbers described in this method are shown in parentheses in the column headings.

Step 1 was performed by listing the code number for each operation in the conventional and ready-food systems. Code numbers are shown in the first column of table 13. A general description of activities performed in each operation is presented in appendix exhibit A.

Step 2 was performed by listing standard labor-time equations for each operation in the conventional and ready-food systems. Standard time values for the intercept and slope are shown in columns 2 and 3 of table 13. These data were obtained from table 12.

¹⁹ U.S. Department of Labor, Bureau of Labor Statistics, Office of Prices and Living Conditions, Producer Prices and Price Indexes, Supplement 1978, Data for 1977, pp. 69., table 4A. Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

²⁰ Ibid.

Step 3 was performed by determining local wage rates for kitchen employees. Sources were State employment commissions, help-wanted advertisements, local newspapers, and employment agencies. Wage rates were then increased to include estimated fringe benefits. Adjusted wage rates are shown in column 4 of table 13.

Step 4 was completed by increasing standard labor-time equations by the sick leave time factor and calculating adjusted labor time, and dividing adjusted labor hours by 173.33 worker-hours per full-time equivalent (FTE) to derive FTE's. Adjusted labor time was then multiplied by adjusted wage rates to derive adjusted labor costs. The vacation-sick leave time factor used in this example was 1.09. The factor was calculated as follows:

Paid holidays	7
Vacation days	10
Paid sick days	5
Total days	22

$260 \text{ total working days} \div 260 \text{ total working days} = 1.09$, the vacation-sick leave factor. Adjusted labor hours for operation 100 were calculated as follows:

$$\begin{aligned}
 Y_t &= S(ax + b) \\
 Y_t &= \text{Standard worker-hours per month} \\
 S &= \text{Sick leave factor (1.09)} \\
 a &= \text{Slope (1,105.11)} \\
 x &= \text{Hundreds of patient beds (3.5)} \\
 b &= \text{Intercept (-790.32)} \\
 Y_t &= 1.09((3.5 \times 1,105.11) - 790.32) \\
 Y_t &= 1.09(3,867.89 - 790.32) \\
 Y_t &= 1.09 \times 3,077.57 \\
 Y_t &= 3,355
 \end{aligned}$$

Adjusted labor hours per month for each operation were computed and listed in column 5 of table 13. Adjusted FTE's for operation 100 were calculated by dividing 3,355 adjusted worker-hours per month by 173.33 worker-hours per FTE, to derive 19.4 FTE's. Adjusted FTE's per month for each operation were computed and listed in column 6 of table 13. Adjusted labor costs for operation 100 were calculated by multiplying 3,355 adjusted labor hours per month by \$10 (adjusted) per hour, to derive \$33,550 per month. Adjusted labor costs per month for each operation were computed and listed in column 7 of table 13.

Step 5 was performed by adding intercepts and slopes of the standard material and services cost equations for

operations of the conventional and ready-food systems to derive total standard system cost equations, and computing the standard total per month. Adjusted materials and services cost totals were computed by multiplying the standard total by producer price index change for finished consumer foods. The addition of intercepts and slopes for conventional-food system operations resulted in the cost equation $14,171.86 + .89$. The addition of intercepts and slopes for the ready-food systems operations resulted in the cost equation $14,807.67X + 46.36$. Total standard system cost for each equation was computed by substituting 3.5 hundred beds for B ($\$49,602$ total standard cost of conventional food system = $.89 + (14,171.86 \times 3.5 \text{ hundred beds}) + .89$). The producer price index change of 1.20 for finished consumer foods was computed by dividing the May 1979 index of 226.8 by the 1977 index of 189.2. These data are shown in column 8 of table 13.

Step 6 was performed in the same manner as step 5 with the exceptions of using standard overhead equations in place of standard material equations, and using producer price index change for finished consumer goods. The addition of intercepts and slopes for conventional system operations resulted in the equation $1,703.74X + 2,190.09$. The addition of intercepts and slopes for ready-food system operations resulted in the equation $1,940.22X + 2,369.07$. The producer price index change of 1.17 for finished consumer goods was computed by dividing the May 1979 index of 178.7 by the 1977 index of 152.2. These data are shown in column 9 of table 13.

Step 7 was performed by adding overhead and adjusted labor, material, and services costs for each system. These data are shown in column 10 of table 13.

A previous cost analysis of the two systems shows the food service director that the ready-food system generates cost savings of \$2,699 per month. Cost savings, which are approximately 2 percent of the total ready-food system cost of \$139,246 per month, does not justify installing the ready-food system for economic reasons. In this particular example, the food service director's recommendation to adopt either the conventional or the ready-food system should be based on comparing such factors as ability to recruit, train, and retain personnel; quality of patient meals; production flexibility; and consistency of product quality.

System Costs For Expansion

In this example, the hospital administrator has requested the food service director to prepare an economic feasibility study of an existing conventional system and a ready-food system for a general hospital expanding from 360 to 500 beds. The existing conventional-food system uses a manual pot-washing operation, a single-service insulated tray-dishwashing operation, and a manual open cart-washing operation. These operations will also be used in the ready-food system.

These steps should be followed by the food service director to determine the costs for each system:

1. Determine the past year's average monthly costs for labor, material, and services of the existing system. Also determine the average monthly hours.
2. Determine and list system operations.
3. Add the standard linear equations to determine total equations for labor hours and costs and costs for materials, services, and overhead.
4. Compute standard labor time, FTE's, and standard costs for labor, material, and services, and overhead for the existing system, using current bed size.
5. Compute adjustment factors for labor time and costs, and costs for materials, services, and overhead. The adjustment factor for labor time and cost and material and services cost is defined as actual existing system data divided by standard existing system data for current bed size. The adjustment factor for overhead is the producer price index change from 1977 for finished consumer goods. The method of computing the overhead adjustment factor (producer price index change) is presented in step 5, "System Costs for New Construction," in this chapter.
6. Compute adjusted existing system labor time, FTE's, and costs for the expanded hospital bed size, and determine total system costs. Adjusted system data is computed by determining the standard time and cost data using the equations developed in step 3 and the expanded hospital bed size, and multiplying the result by the appropriate adjustment factor.
7. Compute adjusted alternative system labor time, FTE's, and costs for the expanded hospital bed size, and determine total system costs. This step is performed in the same manner described in step 6.

Data in table 14 show computation results of the

Table 13.—Estimated monthly cost of conventional and ready-food systems for May 1979.

Operation code (Step 1)	Standard time values (Step 2)		Adjusted labor rate per hour (Step 3)	Adjusted labor time (Step 4)	Adjusted FTE's (Step 4)	Adjusted labor costs (Step 4)	Total Material and services cost (Step 5)	Total overhead cost (Step 6)	Total system cost (Step 7)
	Intercept (a)	Slope (b)							
<i>Conventional</i>	<i>Hours</i>	<i>Hours</i>	<i>Dollars</i>	<i>Hours</i>	<i>Number</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
100	1,105.11	– 790.32	10.00	3,355	19.4	33,545			
200	25.45	.02	5.63	97	.6	547			
300	213.45	706.59	7.50	1,584	9.1	11,884			
400	173.23	883.58	5.63	1,624	9.4	9,143			
510	104.39	—	5.63	398	2.3	2,242			
700	228.28	164.74	6.88	1,053	6.1	7,243			
801	251.88	—	5.63	961	5.5	5,410			
940	105.59	—	5.63	403	2.3	2,268			
1001	27.71	.57	5.63	106	.6	599			
Standard totals				—	—	—	49,602	8,153	141,942
Adjusted totals				9,581	55.3	72,881	59,522	9,539	
<i>Ready-food</i>									
100	1,105.11	– 790.32	10.00	3,355	19.4	33,545			
200	25.45	.02	5.63	97	.6	547			
310	177.52	430.43	6.25	1,146	6.6	7,165			
400	173.23	883.58	5.63	1,624	9.4	9,143			
511	1.85	12.66	5.63	21	.1	117			
600	5.40	20.96	5.63	40	.3	245			
700	228.88	164.74	6.88	1,053	6.1	7,243			
801	251.88	—	5.63	961	5.5	5,410			
940	105.59	—	5.63	403	2.3	2,268			
1001	27.71	.57	5.63	106	.6	599			
Standard totals							51,873	9,160	
Adjusted totals				8,809	50.9	66,202	62,247	10,717	139,246
Net savings of ready-food						6,599	– 2,725	– 1,178	2,696

Table 14.—Estimated monthly expansion costs of conventional- and ready-food systems.

Item description		Action conventional system— 360 beds (Step 1)	Standard conventional system— 360 beds (Step 4)	Adjustment factor (Step 5)	Adjusted conventional system— 500 beds (Step 6)	Adjusted ready-food system— 500 beds (Step 7)	Potential savings— ready-food versus conventional
Labor time—hours	Number	13,000	9,086	1.43	17,509	16,211	1,298
Full-time equivalent employees—number	Number	75.0	52.4	—	101.0	93.5	7.5
Labor cost—dollars		49,085	49,350	.99	66,521	60,951	5,570
Material and services cost—	— do —	57,633	51,678	1.12	80,388	84,000	– 3,612
Overhead cost—	— do —	—	8,196	1.17	12,322	13,915	– 1,593
Total system cost	— do —	—	109,224		159,231	158,866	365

preceding 7-step method for comparing expansion cost estimates of an existing conventional-food system to a ready-food system expanding from 360 to 500 beds. Step number 1, and steps 4 through 7 described in this method, are shown in parentheses in the column headings of table 14.

Step 1 was performed by listing data obtained from the accounting department in column 2 of table 14. The dollars cost for overhead is not shown, as kitchen equipment costs are usually not available.

Step 2 was performed by listing system operation codes. Operation codes for the ready-food system are 100, 200, 300, 400, 510, 700, 801, 920, and 1003. Operation codes for the ready-food system are 100, 210, 310, 400, 511, 600, 700, 801, 920, and 1003.

Step 3 was completed by adding intercepts and slopes for labor hours and costs for the operations listed in step 3. Equations for each operation are shown in table 12. Equations for the conventional system are as follows:

$$\begin{aligned} \text{standard labor hours per month} &= 2,256.01X + 964.02 \\ \text{standard labor cost per month} &= 12,745.51X + 3,465.67 \\ \text{standard material and services cost per month} &= 14,354.88X + .89 \\ \text{standard overhead cost per month} &= 1,668.33X + 2,190.32 \end{aligned}$$

Equations for the ready-food system are as follows:

$$\begin{aligned} \text{standard labor hours per month} &= 2,122.94X + 721.48 \\ \text{standard labor cost per month} &= 11,943.76X + 1,847.40 \\ \text{standard material and services cost per month} &= 14,990.69X + 46.36 \\ \text{standard overhead cost per month} &= 1,904.81X + 2,369.30 \end{aligned}$$

Step 4 was completed by substituting 3.6 hundred beds for X in the conventional system equations shown in

step 3 and completing the calculations. Data resulting from these calculations are shown in column 3 of table 14. Nine thousand and eighty-six standard labor hours per month were derived from $(2,256.01 \times 3.6) + 964.02$. FTE's of 52.4 were derived from 9,086 labor hours per month divided by 173.33 hours per FTE.

The adjustment factor described in step 5 for labor time and cost, and material and services cost, was computed by dividing the actual conventional system data in column 2 of table 14 by the standard conventional system data in column 3 of table 14. The adjustment factor was recorded in column 4 of table 14. The labor-time adjustment factor of 1.43 was derived from 13,000 hours per month divided by 9,086 hours per month. Computation of the overhead adjustment factor is the same as described in "System Costs for New Construction," step 6, using the producer price index change for finished consumer durable goods.

Step 6 was completed by substituting 5.0 hundreds of beds (expanded hospital size) in each conventional system equation developed in step 3 and multiplying the results by the adjustment factors. These data are shown in column 5 of table 14. The labor time of 17,509 hours per month was computed as follows:

$$\begin{aligned} (2,256.01 \times 5.0) + 964.02 &= 12,244 \\ 12,244 \times 1.43 &= 17,509 \end{aligned}$$

Step 7 was completed in the same manner as step 6 with the exception of using the equations for the ready-food system developed in step 3 instead of the conventional system equations.

Previous cost analysis of the two systems shows the food service director that the ready-food system generates cost savings of \$365 per month. These cost savings do not justify installing a ready-food system in the expanded hospital. The ready-food system in this example requires 7.5 FTE's less, or a 7 percent labor time savings, over the conventional system.

Appendix

Exhibit A.—Description of Food Service Operations by Type of Subsystem

Management Subsystem

100 *Management operation*.—Supervising hourly employees; developing production schedules; procuring equipment, material, and supplies; and recruiting and training employees.

200 *Conventional-storeroom operation*.—Receiving, storing, issuing fresh and frozen products and sundry supplies; and preparing and maintaining inventory records and files.

300 *Ready-food storeroom operation*.—Same as operation 200 with the exception of issuing greater quantities during a 5-day work week.

400 *Convenience-food storeroom operation*.—Same as operation 210 with the exception of receiving and issuing convenience and frozen food products.

500 *Conventional food-production operation*.—Weighing and measuring food products in a central ingredient room; transporting measured products to hot-food production stations, transporting hot food to assembly line, preparing and transporting nourishments to the tray-assembly line; cleaning work stations; and general housekeeping.

600 *Ready-food production operation*.—Same as operation 300, with the exception of transporting hot food to operation 600, packaging and freezing operation.

700 *Convenience-food production operation*.—Transporting cold food to tray-assembly line; preparing and transporting salads and similar products to tray-assembly line; preparing and transporting nourishments to tray-assembly line, cleaning work stations; and general housekeeping.

800 *Cafeteria operation*.—Setting up and closing down cafeteria line; serving hot and cold food to customers; operating behind-the-line grill; collecting cash from customers; cleaning work stations; and general cleanup.

900 *Conventional machine pot-washing operation*.—Transporting clean and soiled pots to and from pot-

washing machine; loading and unloading pot-washing machine with pots, pans, and serving utensils, and cleaning work station.

501 *Ready-food machine pot-washing operation*.—Same as operation 500, with the exception of a ready-food subsystem.

502 *Convenience-food machine pot-washing operation*.—Same as operation 500, with the exception of a convenience-food subsystem.

510 *Conventional manual pot-washing operation*.—Same as operation 500, except that pots, pans, and serving utensils are washed manually in a conventional subsystem.

511 *Ready-food manual pot-washing operation*.—Same as operation 510, with the exception of a ready-food subsystem.

512 *Convenience-food manual pot-washing operation*.—Same as operation 510, with the exception of a convenience-food subsystem.

600 *Packaging and freezing operation*.—Manually filling disposable aluminum steam-table pans with hot food products; mechanically sealing pans; labeling pans; transporting sealed pans to and from chilling, freezing, and tempering boxes; transporting tempered products to serving line; and cleaning work station.

700 *Hot-food tray-assembly operation*.—Setting up and closing down hot-food tray line, placing hot and cold food, condiments, beverages, and silverware on patient trays; checking trays for order accuracy; loading trays into food cart; and cleaning work station.

710 *Chill-plate tray-assembly operation*.—Same as operation 700, except that hot food is deleted.

Tray Delivery and Sanitation Subsystem

801 *Conventional pantry, tray-delivery operation*.—Transporting hot patient meals and soiled dishes to and from patient rooms via a reserved service elevator; transporting nourishments to and from a floor pantry, and general cleaning of floor pantry work station.

- 803 *Microwave pantry, tray-delivery operation.*—Transporting cold patient meals (in a closed cart) and soiled dishes to and from a floor pantry via a reserved service elevator; storing and removing food from refrigerated cabinets; reheating meals in microwave ovens; transporting hot food to and from patient rooms; transportation of nourishments and soiled dishes to and from floor pantry; and general cleaning of floor pantry work station.
- 805 *Convection pantry, tray-delivery operation.*—Same as operation 803, except that meals are reheated in convection oven.
- 806 *Integral-heat pantry, tray-delivery operation.*—Same as operation 803, except that food is reheated in modular dishes placed on electrified rails in heating cabinet.
- 900 *Pellet-base dishwashing operation.*—Transporting soiled and clean dishware to and from a dish machine; washing soiled trays, permanent-ware dishes and silverware for cafeteria patrons and patients; washing stainless-steel plate bases and covers for patients; and performing general cleanup of work station.
- 910 *Split-tray and chill-plate dishwashing operation.*—Same as operation 900, with the exception of washing divided-tray and plastic-plate covers for patients.
- 920 *Single-service insulated tray-dishwashing operation.*—Transporting soiled and clean insulated tray bases and covers to and from a dish machine for patients; transporting and compacting single-service dishware and eating utensils for patients and cafeteria patrons; and performing general cleanup of work station.
- 930 *Integral-heat dishwashing operation.*—Same as operation 900, with the exception of washing modular dish bases and covers for patients.
- 940 *Single-service dishwashing operation.*—Same as operation 920, with the exception of transporting soiled and clean trays to and from a dish machine for patients and cafeteria patrons.
- 1001 *Manual closed cart-washing operation.*—Transporting soiled and clean carts into and out of steam-cleaning room; raising cart from floor and manually steam cleaning and performing general cleanup of work station.
- 1002 *Manual hot-cold cart-washing operation.*—Same as operation 1001.
- 1003 *Manual open cart-washing operation.*—Same as operation 1001.
- 1011 *Machine closed cart-washing operation.*—Transporting soiled and clean carts into and out of cart-washing machine; washing two carts per cycle; and performing general cleanup of work station.
- 1012 *Machine hot-cold cart-washing operation.*—Same as operation 1011.
- 1013 *Machine open cart-washing operation.*—Same as operation 1011.

